



# CHEM-NUCLEAR SYSTEMS INC.

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July 20, 1979

Robert Baer, Chief  
Light Water Reactor Branch #2  
Division of Project Management  
U. S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Baer:

Forwarded to you under separate cover are 40 proprietary copies and 20 non-proprietary copies of Chem-Nuclear's Solidification Topical Report, for your review.

If you have any questions or if any additional information is needed, please do not hesitate to contact us.

Thank you for your cooperation in this matter.

Sincerely,

CHEM-NUCLEAR SYSTEMS, INC.

Louis E. Reynolds  
Director  
Regulatory Affairs

LER/cm

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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

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ABSTRACT

Chem-Nuclear Systems, Inc. (CNSI) MOBILE RADWASTE SOLIDIFICATION SYSTEM is designed to receive and route low-level, liquid radioactive waste from a facility to a transport container where the waste is de-watered and/or solidified and the container is sealed for transport.

CNSI's MOBILE RADWASTE SOLIDIFICATION concept incorporates a urea formaldehyde/acid catalyzed solidification process in a Mobile Unit. Two types of Mobile Units are in operation: an all-weather trailer model and a more portable skid-mounted unit for in-plant use.

Mobile Solidification is accomplished in accordance with a Process Control Program which is designed to insure that each batch of rad-waste the Mobile Unit receives is capable of being solidified into a monolithic, freestanding solid with no free water.

All systems operations are conducted in accordance with the "as low as reasonably achievable" concept. All automatically sequenced waste transfers and flushing processes are remotely operated from a low radiation area. Operating equipment which comes into contact with waste material is stainless steel. Industrial safety and radiation protection policies of CNSI are defined and enforced. CNSI's Quality Assurance Department insures that MOBILE RADWASTE SOLIDIFICATION SYSTEM operations which relate to safety are monitored and controlled.

The MOBILE RADWASTE SOLIDIFICATION SYSTEM is designed and operated in accordance with the current applicable industrial and nuclear regulatory requirements. The present system's operation and design theory is based on CNSI's operating experience and research and development findings of the past five years.

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1.0 SCOPE

1.1 Purpose

This topical report describes the design and operation of Chem-Nuclear Systems, Inc. (CNSI) MOBILE RADWASTE SOLIDIFICATION SYSTEM. A discussion of individual issues which relate to the safe operation of a Mobile Unit at a customer site is also included. The report is intended to provide the Nuclear Regulatory Commission with sufficient information to evaluate CNSI's MOBILE RADWASTE SOLIDIFICATION SYSTEM.

1.2 Applicability

The information presented in this document applies only to CNSI's MOBILE RADWASTE SOLIDIFICATION SYSTEM.

2.0 SYSTEM DESCRIPTION

2.1 General

Chem-Nuclear Systems, Inc., MOBILE SOLIDIFICATION SYSTEM processes low-level, liquid radioactive waste for shipment and disposal in accordance with current governing regulations. The MOBILE SOLIDIFICATION SYSTEM is used in conjunction with existing IN-PLANT radwaste processing and volume reduction systems. The system is designed to:

- a. receive and route low-level, liquid radioactive waste to a disposable, shipping liner
- b. dewater resins and other waste types
- c. solidify radwaste within the disposable, transport liner
- d. remotely flush the system lines after a radwaste transfer process
- e. seal the transport liner (trailer units only)

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The system controls encompass both manual and automatic sequencing for the above processes. The control area is located in a low-radiation area or a shielded area to maintain operator exposure levels as low as reasonably achievable. The control area houses all the necessary operating controls, process indicators and monitoring device readouts for complete remote operation of automatic processes from that area. A closed-circuit television (CCTV) system provides indirect visual monitoring of the processes occurring within the radwaste transport container.

Housings for the Mobile Units' equipment are designed for either outdoor or in-plant operation. All-weather trailers house the operations for outside processing. In-plant processing utilizes the modular skid-mounted units.

## 2.2 Waste Transfer and Container Filling

Waste transfer and container filling is a one-step process (Fig. 1). However, it is a joint operation between the facility's radwaste operator and the CNSI Mobile Unit operator. A safe and efficient waste transfer requires close cooperation between both operating technicians.

Prior to any waste transfer, CNSI's Mobile Unit operator prepares the transport container to receive waste and performs a series of preoperational tests. These tests are designed to confirm the proper operation of all mechanical equipment, control instrumentation and monitoring devices. Preparation of the radwaste container includes insertion of the air sparge manifold and dewatering leg (if required), calculation and setting of the level sensing probes on the sparge tube, and attachment of the filling head to the container. A maximum of five container level settings are used for monitoring the container level: a

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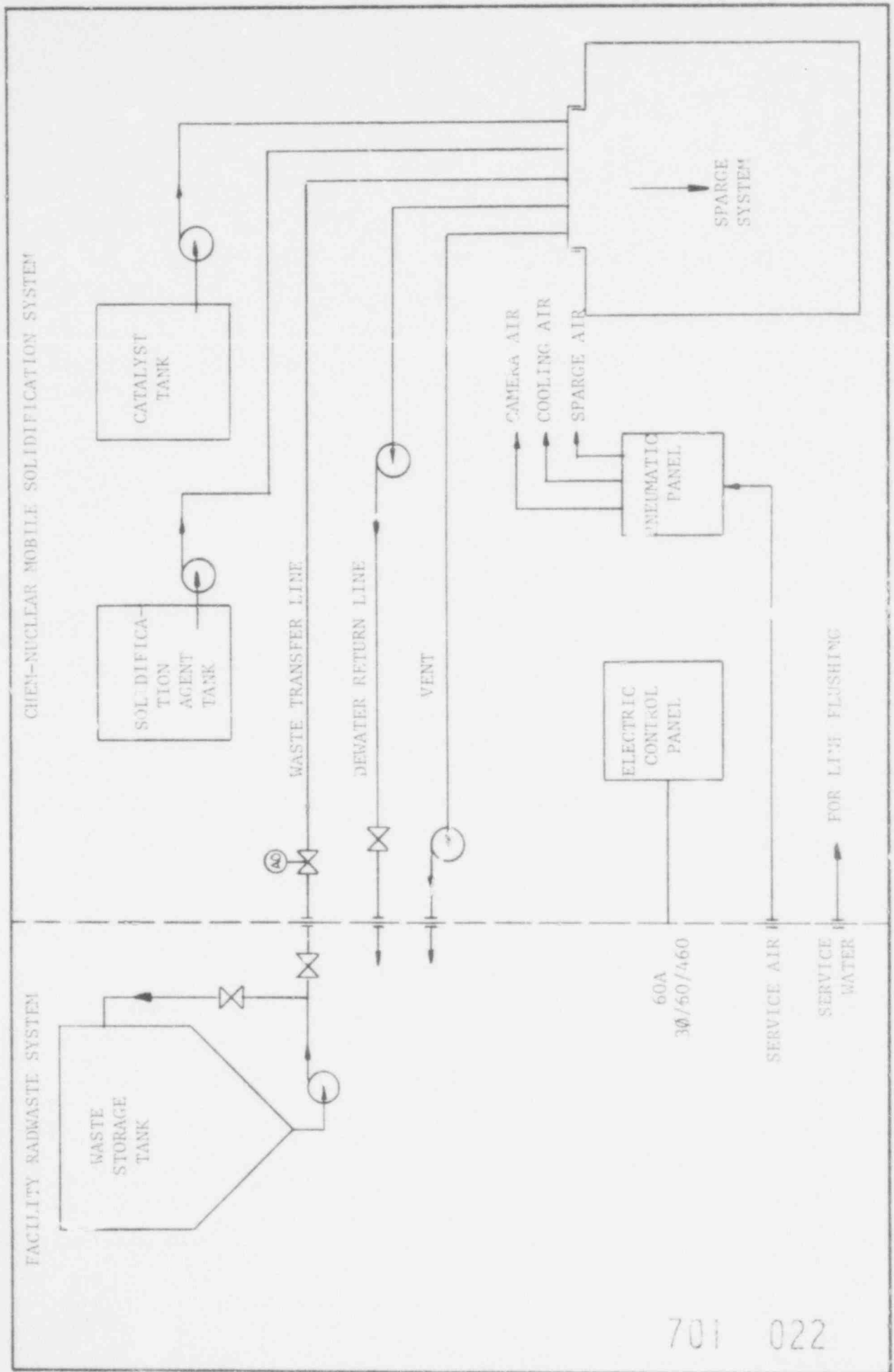
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FIGURE 1. WASTE FLOW; MOBILE UNIT AND FACILITY INTERFACE



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a waste level, a solidification agent level, a dewater level, a container high level and a container Hi-Hi level.

When the Mobile Unit is ready to accept waste, the operator alerts the facility radwaste operator to begin waste flow to the Unit. The waste transfer is accomplished by means of the plant's radwaste pumps. Continual monitoring of the container level is achieved through surveillance of the CCTV monitor and the level probe readouts. When the precalculated level is reached, the Mobile Unit operator alerts the facility's radwaste operator to stop waste flow to the Mobile Unit. Each unit is equipped with a waste transfer control valve (the waste inlet valve, Fig. 1) which in case of an emergency provides the CNSI operator with control of the radwaste flow to the transport container.

Waste transfer from a facility also includes a facility flush to clear the lines of waste material. A Mobile Unit flush follows the facility flush. The Unit flush is controlled by the Mobile Unit's operator and is designed to return the Unit waste piping and hoses to background radiation levels. The flushing water is considered radwaste and is put into the shipping container. The estimated volume of the flush water is considered when the waste level setting is calculated. The transfer of radwaste from the facility to the shipping container is complete after Mobile Unit flushings.

### 2.3 Radwaste Dewatering

Resins and various other radwastes are suspended in a sludge water to facilitate their movement thru piping. The dewatering process recovers this sludge water from the radwaste after its transfer to the shipping container. The sludge water is removed from the container through a

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dewatering leg fitting with a filter at the suction end and pumped back to the facility for reprocessing.

Dewatering the waste within the shipping container results in the reduction of the volume of material within the container. If after the initial dewatering the level of the dewatered material in the container falls below the predetermined maximum waste level, more waste is added to the container and again dewatered. This cyclic process is continued until the container holds the maximum allowable volume of dewatered waste.

#### 2.4 Radwaste Solidification

The solidification of liquid radioactive radwaste is a three-step process accomplished completely within the shipping container (Fig. 2). Urea formaldehyde (UF) is used as the solidification agent, and sulfuric acid as the reaction catalyst.

The initial step in the solidification process is the addition of solidification agent to the radwaste in the shipping container. The solidification agent is transferred to the container in a predetermined volume depending upon the waste type. Normally a 2:1 waste to solidification agent ratio is used for liquid wastes and a 3:1 ratio is used for concentrated resin slurries. Throughout steps 1 and 2, a sparging system agitates the waste solidification agent mixture to insure uniform mixing. The sparge system creates uniform, turbulent mixing by releasing air streams at the rate of 20 - 50 scfm through an array of orifices in a distribution manifold in the bottom of the container.

The addition of the acid catalyst is the second step of the solidification process. The sulfuric acid is pumped into the waste container through the air sparge system to insure complete distribution and mixing.

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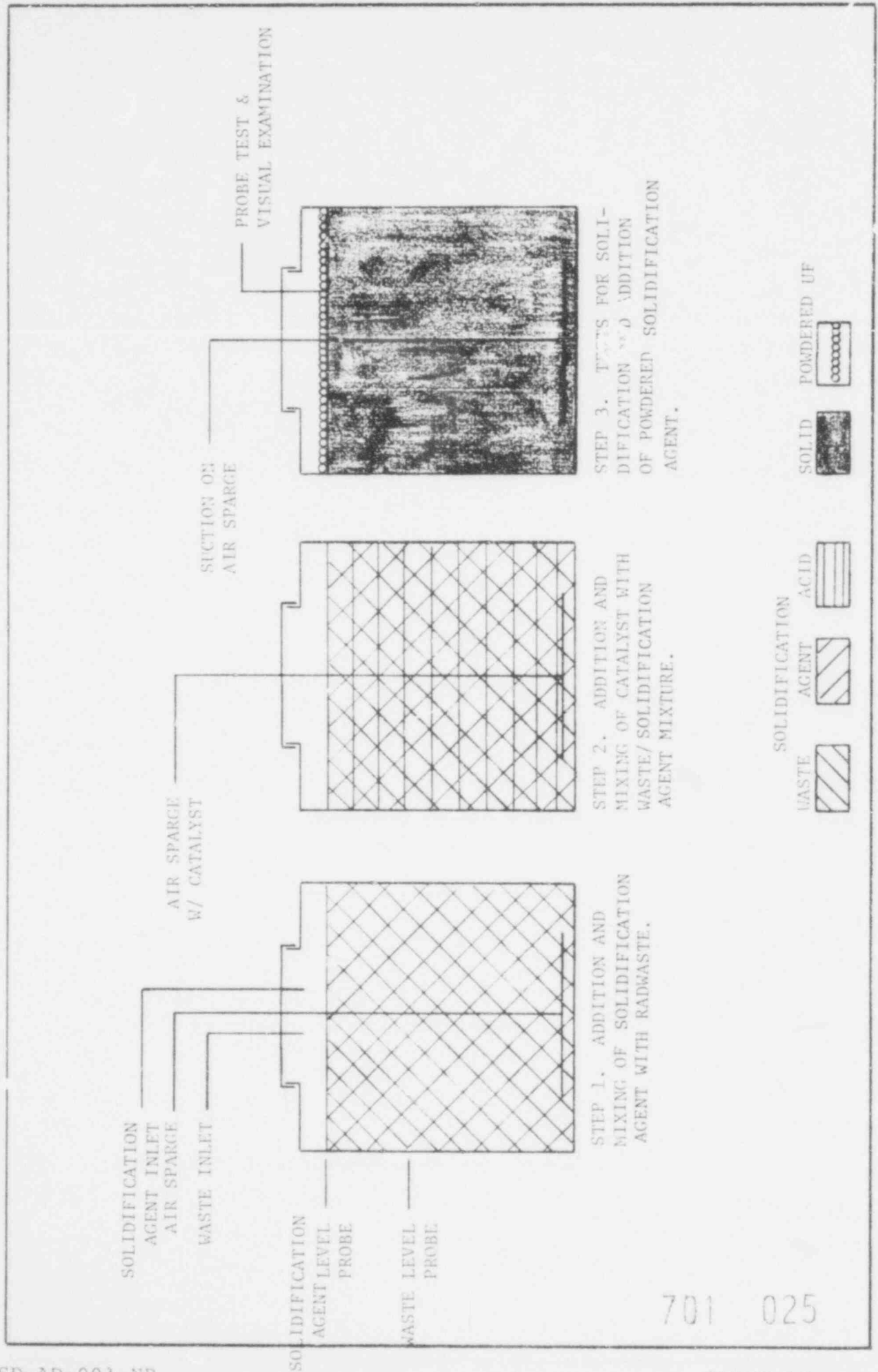
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FIGURE 2 THE 3-STEP WASTE SOLIDIFICATION PROCESS



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Solidification of the waste mixture occurs between pH2 and pH3. The quantity of catalyst needed to achieve this pH depends upon several factors including the initial pH of the waste material and the buffering capacity of the waste. Therefore no specific ratios of catalyst to waste are specified. When the pH is reduced sufficiently, the waste/solidification mixture becomes opaque and the viscosity increases noticeably. At this point, catalyst addition is stopped. Visual monitoring of the solidification point thru the CCTV system gives the operator remote visual monitoring capabilities. A viewing port on the fillhead allows for direct visual observation of the waste.

The third step in the solidification process is a test for complete solidification followed by the addition of a powdered solidification agent to the container. Testing of the solidified waste for thorough, uniform solidification and for the presence of free water consists of a visual examination, a probe test and a suction test. After confirmation of a uniform and completely solidified product, the operator completes the third step of the solidification process by adding precatalyzed, powdered solidification agent to the shipping container to insure that any free water which develops during transport and disposal is solidified. The container is ready for capping.

#### 2.5 Container Capping

Three types of container closure methods are used within CNSI operations: the CNSI Crimp-A-Cap closure, the bolted ring closure and the lever-type closure. The Crimp-A-Cap closure method offers remote capping of the shipping liner and is used whenever possible. The bolted ring or lever-type closure methods are used when the Crimp-A-Cap equipment is not available or is incompatible with the cask/liner configuration.

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### 3.0 PROCESS CONTROL PROGRAM

#### 3.1 Program Design

The process control program for CNSI's MOBILE RADWASTE SOLIDIFICATION SYSTEM is designed to provide assurance of the satisfactory solidification of wet radioactive waste with the absence of significant free water.

The program consists of procedures for sample collection and analysis for the determination of specific solidification process parameters. Acceptance criteria and program variations are also included.

#### 3.2 Waste Sample Collection Techniques

Representative samples are obtained from the first batch and every tenth batch thereafter of each type of radwaste processed through a Mobile Solidification Unit. The process parameters for that waste type are determined prior to any solidification. A representative sample consists of a one liter midstream sample from a single transfer batch or a one liter composite sample from a multi-transfer batch. A 'batch' of radwaste is defined as the amount of waste required to fill one disposable liner to its maximum waste level setting either in a single or multiple transfer.

Typical waste types processed through the Mobile Units are filter sludges, spent resins, evaporator bottoms, boric acid solutions, sodium sulfate solutions and filter media. If the radiation levels of the sample prevent collection of a full liter sample, the maximum volume is limited to acceptable radiation levels.

Evaporator bottoms or other hot samples are collected in stainless steel thermos bottles to simulate field conditions. If the waste type is normally dewatered prior to

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solidification (e.g., resin beads), the transport water is decanted prior to test solidification.

### 3.3 Sample Analysis & Acceptance Criteria

The following chemical analyses are performed according to the waste type:

#### a. Evaporator Bottoms

- (1) pH
- (2) specific gravity
- (3) oil content
- (4) sulfate concentration
- (5) boron concentration
- (6) detergent content

#### b. Filters and Sludges

- (1) oil content
- (2) detergent concentration

#### c. Resin Beads Sluice Water

- (1) oil content
- (2) detergent concentration
- (3) pH

The representative waste samples are test solidified using routine solidification parameters. If any test specimen fails to solidify, the batch in the liner is not solidified until acceptable alternate solidification parameters are determined and test-solidification verified. The batch is then solidified using the alternate parameters. If the specimen which fails to solidify is from the first batch of a waste type, a sample from each consecutive batch of the same waste type is collected and test-solidified until three consecutive samples solidify. After the third consecutive solidification, the normal sampling pattern is resumed.

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Acceptance criteria for sample test-solidification are:

- a. less than 0.1% free-liquid present after powdered solidification agent addition
- b. the solid matrix maintains its shape if removed from the test vessel.

A qualitative foaming test is performed on all waste samples by adding some catalyst to a small quantity of waste. If foaming occurs, an anti-foaming agent is added to the waste sample and the sample retested. Proportionate quantities of the anti-foaming agent are added to the waste batch if the anti-foaming test is positive. If the oil content of the waste sample is greater than 1%, the oil is removed from both the sample and waste batch by skimming or a demulsification agent is added. If the pH of the waste sample is less than 3, sodium hydroxide is added to the sample to raise the pH to above 3 prior to the addition of the solidification agent. The proportionate quantity of the caustic is used during actual batch solidification.

If unacceptable solidification results from excessive foaming, the following items are explored to reduce subsequent foaming:

- a. types and quantities of anti-foaming agent
- b. lowering of the pH of the waste prior to the addition of the solidification agent
- c. reducing the rate of catalyst addition.

Test solidification is repeated and results recorded. If unacceptable solidification results from excessive free-liquid or a too soft matrix, the waste/solidification agent ratios are adjusted by lowering the waste volume in increments of 0.5 until a test-solidification falls within acceptable limits.

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### 3.4 Records

A process control program form (PCP-1) is completed for each test solidification. The following data are recorded on the PCP-1 form for future reference:

- a. pH of waste
- b. waste oil content
- c. solidification agent/waste ratio
- d. solidification agent/acid ratio.

The following data are recorded for all batch solidifications:

- a. waste type
- b. level probe set points
- c. sparge air pressure, flow rate, sparging time
- d. total waste received
- e. total solidification agent added
- f. total catalyst added
- g. percentage of free-standing water
- h. batch number.

### 4.0 EQUIPMENT DESCRIPTION

The design and construction of the Mobile Solidification Units are geared towards the efficient processing of radioactive waste while maintaining personnel radiation exposure levels as low as reasonably achievable. The design minimizes the probability of accidental release of radioactive material to the surrounding environment. All Mobile Solidification Units are designed and fabricated to meet the applicable DOT and NRC standards. Units are continually retrofitted to comply with the most current standards. Figure 3 is a typical piping and instrumentation diagram for a Mobile Solidification Unit.

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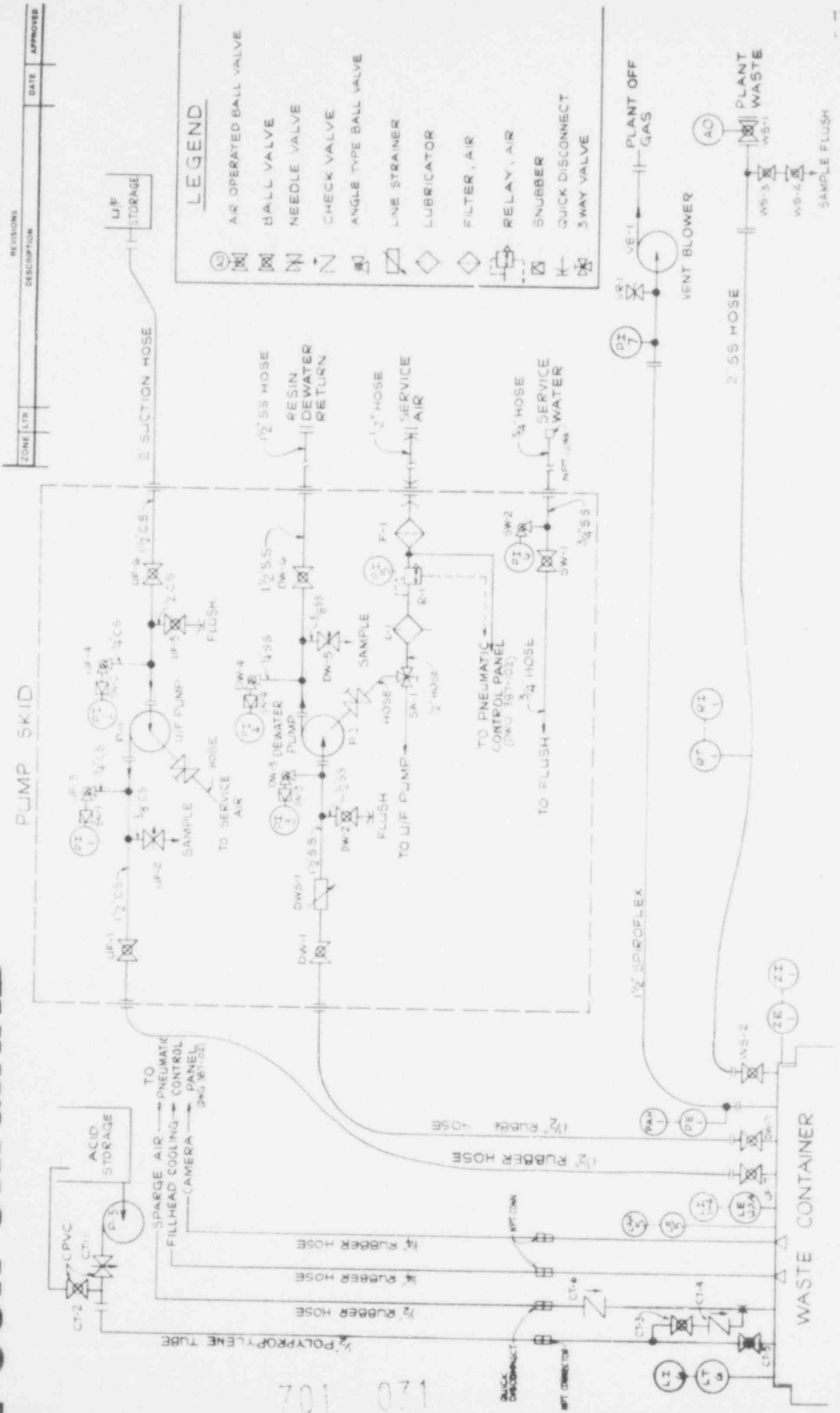
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**FOOT ORIGINAL**

FIGURE 3 TYPICAL P&ID FOR A MOBILE SOLIDIFICATION UNIT



## 4.1 Piping and Hoses

### 4.1.1 Piping

The process piping assemblies are mounted within a trailer housing or on a portable skid. The structural welding is in accordance with American Welding Society Standards (AWS). The radioactive material for solidification is processed in teflon-lined stainless steel hose or stainless steel pipe. The remaining system piping is carbon steel, PVC or CPVC. The piping is commercial grade and compatible with its intended use (e.g., acid resistant, etc.). The design of the piping assemblies provides a free-flowing path with minimal pressure drops between the utility and the container. The arrangement of the pipes on the skid or in the trailer provides easy access to individual pipes, valves and other equipment for troubleshooting and maintenance purposes. Process piping is pressure rated to a minimum of 150 psi and pressure tested according to ANSI B31.1 prior to any transfer.

### 4.1.2 Hoses

#### a. Solidification Agent Transfer Hoses

Solidification agent is transferred from its storage tank to the waste container through a PVC suction hose and a neoprene discharge hose. PVC and neoprene are chemically compatible with urea formaldehyde.

#### b. Catalyst Transfer Hose

The catalyst transfer hose is a 1/2-inch diameter hose of flexible polypropylene or polyethylene with a minimum pressure rating of 100 psi. Polypropylene or polyethylene are chemically compatible with the acid catalyst.

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c. Vent Hoses

The vent hoses are fabricated of PVC. The vent hoses are pressure rated for a full vacuum and are chemically compatible with acid vapors which may be released during catalyst addition.

d. Service Air Hoses

Air hoses are fabricated of synthetic rubber with a minimum pressure rating of 150 psi.

4.2 Valves

System valves are either air or manually operated. The air-operated valves are controlled by a  $100 \pm 20$  psi service air supply. The air is distributed to the various valves thru a pneumatic control panel. All the air-operated system valves are fail-closed on the loss of air pressure.

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#### 4.3 Fillhead Assembly

The fillhead assembly is mounted directly on the waste container. It houses the access ports to the waste container and the waste filling monitoring devices (Table 1).

TABLE 1

List of access ports, attachments and monitoring devices in the fillhead.

Access Ports	Waste/ Solidification Agent Catalyst Air: Sparge, Camera, Cooling, Vent Dewater Return
Attachments	Dewater Leg Air Sparge Manifold
Monitoring Devices	Container Level Probe: Dewater, Waste, UF, High, High-High Closed-Circuit Viewing Camera Camera Air Temperature (optional) pH (optional)

The fillhead is a single unit constructed of stainless steel or carbon steel. The fillheads fabricated from carbon steel are painted with an acid resistant paint. The transfer connections are leak-tight and flanged to prevent the release of any radioactive material, liquid or airborne, into the surrounding environment. A positive seal between the container and the fillhead is insured by a neoprene gasket on the fillhead's seating surface.

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#### 4.4 Storage and Processing Containers

##### 4.4.1 Disposable Liners

CNSI's disposable liners range in size from 55-gallon drums (7.35 ft<sup>3</sup>) to 300 ft<sup>3</sup> liners. The shipping liners are constructed of carbon steel in accordance with CNSI's Quality Assurance Program and pressure tested to 5 psi prior to use. Type A transport liners are licensed by the NRC as highway transport and burial containers.

##### 4.4.2 Solidification Agent Storage Container

Solidification agent storage containers are constructed of industrial grade materials which are chemically compatible with urea formaldehyde. The containers range in size from 55-gallon drums (7.35 ft<sup>3</sup>) to 300 ft<sup>3</sup> shipping liners. The container size depends upon the demand at individual facilities.

##### 4.4.3 Catalyst Storage Tank

Catalyst storage tanks are 75-gallon fiberglass holding tanks or 55-gallon polyethylene carboys. Fiberglass and polyethylene are chemically compatible with the acid catalyst.

#### 4.5 Pumps

##### 4.5.1 Dewatering Pump

The dewatering pump is an air-operated, diaphragm pump capable of transferring up to 100 gallons per minute. The pump is fabricated of stainless steel. The pump is powered by a 100 ± 20 psig air supply. The pump design provides a maximum Total Suction Head of 20 ft at 40 gpm to insure effective dewatering of resin beads and powder wastes.

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#### 4.5.2 Solidification Agent Transfer Pump

The solidification agent transfer pump is an air-operated diaphragm pump capable of transferring up to 100 gallons per minute. The pump is fabricated of aluminum or cast iron. The pump is powered by a 100 ± 20 psig air supply.

#### 4.5.3 Off-Gas Blower

The off-gas blower is a radial, single stage, centrifugal compressor used to maintain a negative pressure within the fillhead. The blower draws a minimum of 100 scfm at 5 inches of water. A pressure release valve on the intake side of the pump insures that the pressure draw on the fill-head stays within acceptable limits.

#### 4.6 Sparge Tube Assembly

The sparge tube is a disposable air distribution manifold. It is constructed of CPVC which is chemically compatible with all chemicals used in the solidification process and capable of withstanding the high temperature waste streams (up to 180°F) encountered at pressure water reactors. The distribution manifold is contained entirely within the shipping container.

#### 4.7 Capping Equipment

##### 4.7.1 CRIMP-A-CAP

The CRIMP-A-CAP is a remotely operated container lid crimping system which consists of a crimping head, a hydraulic power supply, a light duty crane and connecting hoses. The capping head is an epoxy-coated, carbon steel assembly with twelve hardened steel crimping fingers. A

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standard type industrial grade 1/2-ton (minimum) crane is used for positioning the fillhead. The hydraulic power supply is an electrically driven industrial grade unit which is capable of continuously delivering a minimum pressure of 3,500 psi. The connective hose assemblies are rated at 4,000 psi. A safety valve prevents pressure build-up greater than 3,300 psi.

4.7.2 Bolted-Ring Closures

The bolted closure rings meet DOT requirements (49 CFR 178.118) for closure devices for 17H steel drums.

4.7.3 Lever-Type Closure

Lever-type closure rings are fabricated of commercial grade steel and have a locking clip for the lever arm.

4.8 Radiation Monitoring Equipment

An AC operated Geiger-Mueller (GM) detector monitors waste stream activity entering the unit. A laboratory assay for radioactivity is performed by the facility's health physics department for each waste batch.

4.9 Unit Housing

4.9.1 All-weather Trailer

The MOBILE SOLIDIFICATION SYSTEM'S all-weather trailers are dual-axle trailers with stationary leveling devices. The units are self-contained except for service air, service water and electrical power connection, which must be supplied by the facility. A 1/2-ton telescoping boom crane

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s, provided for handling cask access plugs, fill-head, and capping head.

5.4.2 Skid Mount

The skid mount frames are carbon steel and mounted on casters to facilitate deployment and stowage. The skids are provided with leak-tight stainless steel drip pans to contain spillage of radioactive material within the skid boundary.

5.0 SAFETY CONSIDERATIONS

5.1 Radiation Protection

5.1.1 System Design

Radiation protection measures for CNSI'S MOBILE SOLIDIFICATION SYSTEM begin with the basic design of the individual Mobile Unit. Each unit is designed to maintain radiation levels to as low as reasonably achievable. Design features which illustrate this philosophy include:

- a. remote operation of waste transfer processes from either a low radiation area
- b. remote operation of flushing sequences for the waste and solidification agent lines to prevent radiation buildup
- c. remote monitoring of automatic processes
- d. strategic placement of flow control valves for isolation of individual system components
- e. use of stainless steel components which come into contact with radioactive material during solidification.

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5.1.2 On-site Radiation Protection

On-site radiation protection measures are closely interfaced with the facility's radiation protection program. The MOBILE SOLIDIFICATION SYSTEM'S operating procedures are reviewed by the facility prior to operation to determine if the system meets the requirements of the Customer's Final Safety Analysis Report.

Specific CNSI-required radiation monitoring procedures for each unit utilize both portable radiation instrumentation and facility radiation detection instrumentation. The following surveys are performed to meet CNSI requirements:

- a. daily radiation survey of the unit and the immediate area
- b. hourly radiation surveys of the unit and immediate area during unit operation
- c. continual in-line monitoring of the radwaste transfer line's radiation levels during waste transfer and flushing operations
- d. radiation surveys of the exterior of the transport cask or liner before and after filling with processed waste
- e. radiation surveys of the filling head following each container filling
- f. radiation survey of the unit and immediate area following unit operation.

CNSI operating procedures require the following radiation protection measures to be followed at all times.

- a. Appropriate protective clothing must be worn when performing any work activity which has a potential for contamination.
- b. The Unit's operators must remain at a "safe" distance or in a shielded area as much as possible during all routine operations.

## 5.2 Industrial Safety & Fire Protection Program

### 5.2.1 Program Design

CNSI's safety and fire protection requirements satisfy the current industrial standards for operating equipment and operating procedures. The Mobile Units are designed to meet the applicable requirements of the Occupational Safety and Health Act (OSHA). The Unit's design and operation must meet or exceed the customer's standards.

The Mobile Units are built in compliance with the current National Electrical Code (NEC). Loads, wiring, circuit breakers, motor starters and overload heaters, fuses, and grounding are installed in accordance with applicable NEC subsections. The units are equipped with a 600 volt, 100 amp AC-grounded input power connector and fused disconnect switch. The main power disconnect feeds a 480 VAC/240-120 VAC 25KVA transformer.

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The transformer secondary feeds a 100 amp main circuit breaker panel which supplies power via a 20 circuit panel for instrumentation, control and heating.

No flammable materials are used in the solidification process. Urea formaldehyde has a flash point of 500°F and is self-extinguishing. UF has been tested in accordance with the requirements of ASTM-E84, UL 723.

5.2.2 Unit Safety Equipment

Each unit is equipped with two 5 lb CO<sub>2</sub> type fire extinguishers specified for use on Class B and C fires. Each Unit is also equipped with first aid kits which include eye flushing equipment, face shields and protective clothing. While on a customer site, the customer's fire fighting unit will provide equipment for any Mobile Unit emergency.

6.0 EQUIPMENT ARRANGEMENT

6.1 Utility Interface Requirements

The physical and operational requirements for the Mobile Solidification Unit's trailer or skid mount design are:

- a. an adequate working area
- b. a 20A-3Ø-480V power supply
- c. a 100 scfm, 100 psi service air supply
- d. a 20 gpm, 100 psi service water supply
- e. a 2-inch, 150 lb flanged waste connection

- f. a 1 1/2-inch, 150 lb flanged vent air connection
- g. a 1 1/2-inch, 150 lb flanged sluice water return connection (dewater return)
- h. a 1/2 ton crane (skid-mounted units only).

## 6.2 On-site Equipment Arrangements

### 6.2.1 Trailer Units

A typical arrangement for all-weather trailer units at a customer facility is illustrated in Figure 4. This arrangement insures that the liner is in a working proximity to the trailer crane. The suggested arrangement emphasizes minimum transfer line distance for all materials, especially the radioactive waste.

### 6.2.2 In-plant, Skid Mounted Units

A typical arrangement of a skid-mounted unit within a facility's radwaste building is illustrated in Figure 5. This arrangement minimizes the waste transfer distance from the facility's waste discharge line to the truck loading bay, therefore maintaining exposure levels to as low as reasonably achievable.

## 7.0 OPERATING EXPERIENCE (HISTORY)

CNSI's experience with Mobile Solidification over the past five years consists of on-site processing of radioactive waste at 16 nuclear facilities. CNSI is presently operating third generation units which were built or retrofitted to incorporate design modifications based on previous operating experience and changed regulatory requirements.

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UTILITY  
RADWASTE  
BUILDING

**POCC ORIGINAL**

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PLANT REQUIREMENTS

ELECTRICAL: 20A 3Ø 480V  
 SERVICE WATER: 25 GPM @ 100 PSI  
 SERVICE AIR: 100 SCFM @ 100 PSI  
 WASTE: 2" 150 LB FLG. CONN.  
 VENT: 1 1/2" 150 LB FLG. CONN.  
 DEWATER: 1 1/2" 150 LB FLG. CONN.

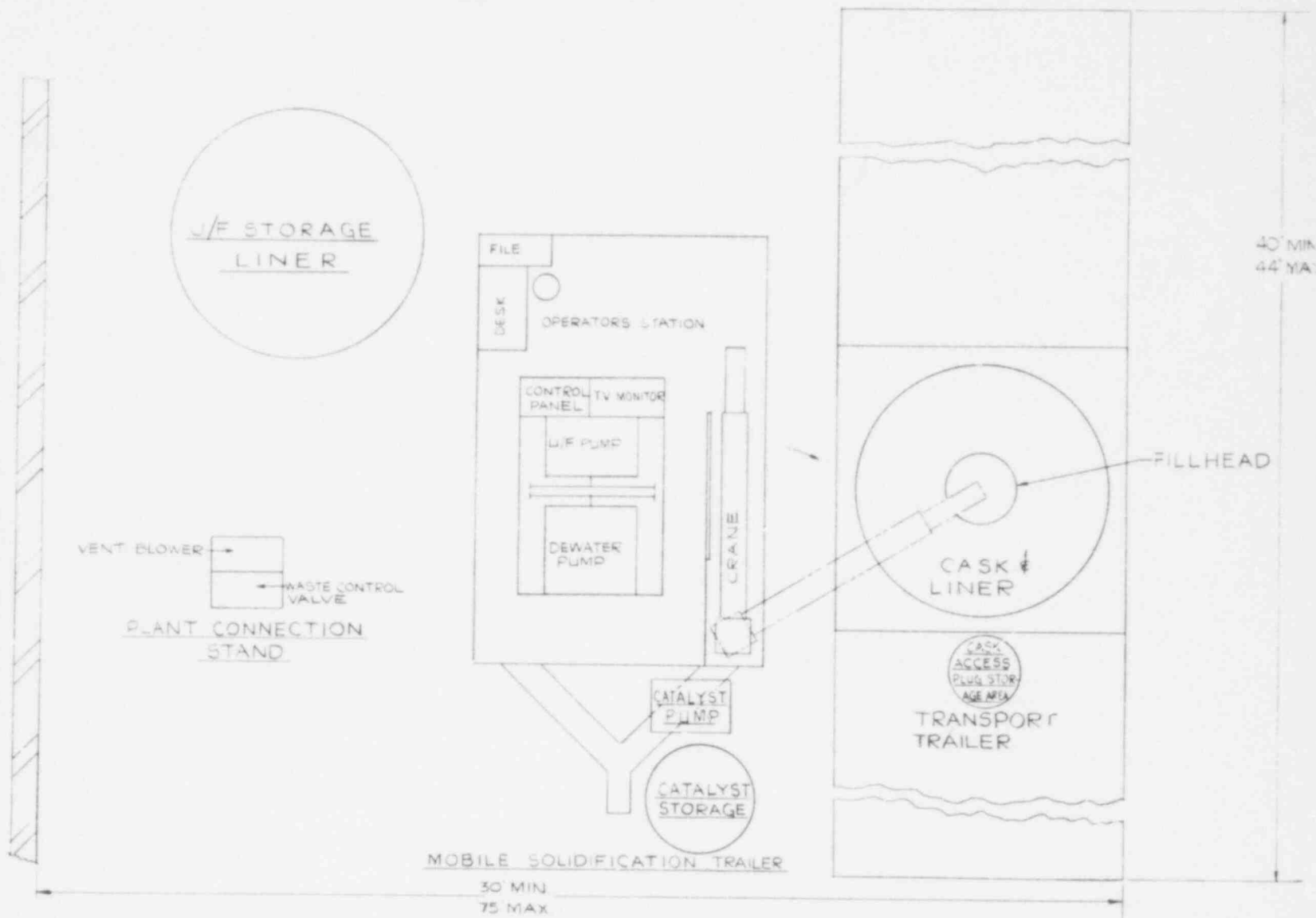


Figure 4. Sample Arrangement of a Trailer Housed Mobile Solidification Unit



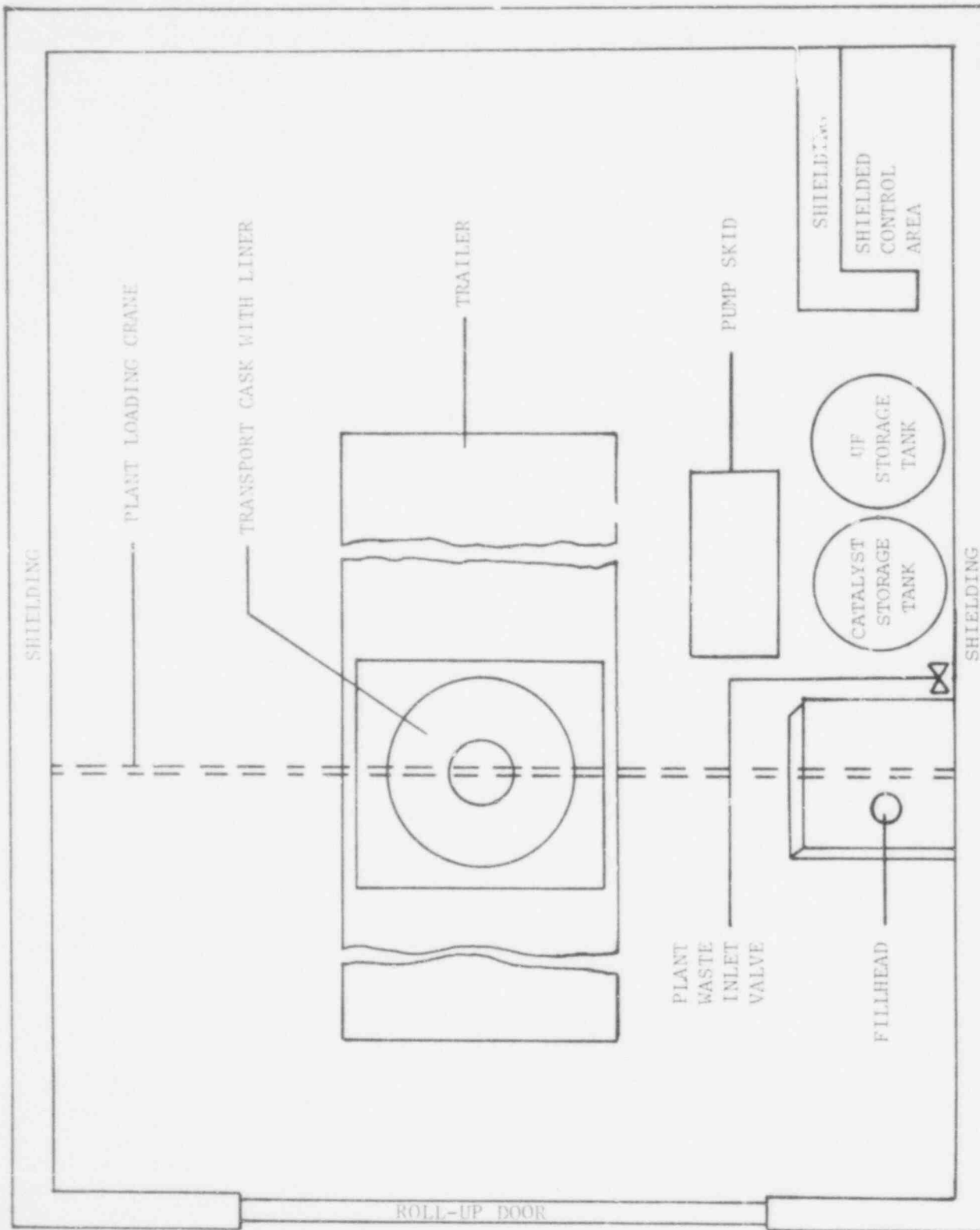


FIGURE 5. SAMPLE IN-PLANT ARRANGEMENT OF A SKID-MOUNTED MOBILE SOLIDIFICATION UNIT

CNSI's first generation of mobile solidification units consisted of one unit released in early 1974 and one unit released in early 1975. Combined, these units serviced six nuclear facilities. These first units were designed as completely self-contained radwaste solidification systems. They were housed in 45-foot trailers and were equipped with an internal generator and air compressor. Storage tanks for the solidification agent and the catalyst were also housed within the trailer. An inline mixing process for the radwaste and solidification agent was employed. These units are no longer in service.

CNSI's seven second-generation mobile solidification units, built in 1977 and 1978, incorporated design changes based on the operating experience of the first two units. Portable, skid-mounted units were developed for use within a facility's radwaste building. The solidification function and basic operational design of both trailer and skid units are identical. These seven units are still in operation. Combined, they have served sixteen nuclear facilities over the past two years.

Changes and clarifications of the regulatory guidelines pertaining to Mobile Solidification Systems and continued design refinements again led to changes within the MOBILE SOLIDIFICATION SYSTEM. The second-generation units were retrofitted to meet these changes, and a third generation of Mobile Solidification Units was engineered to reflect the new design requirements.

Currently, the mobile solidification units are regularly servicing four nuclear facilities on a regular basis. Table 2 lists the volume and types of radwaste CNSI processed over a three-year period.

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Table 2 Volumes and type of waste processed over a three-year period.

Utility	Vol. of Powdex	Vol. of Bead Resin	Vol. Evaporator Bottoms	Vol. of RWCU	Vol. of Sludge
a	6,650 ft <sup>3</sup>	-	69,200 ft <sup>3</sup>	-	-
b	-	-	70,400 ft <sup>3</sup>	522 ft <sup>3</sup>	2,450 ft <sup>3</sup>
c	-	600 ft <sup>3</sup>	25,600 ft <sup>3</sup>	-	-
d	-	-	27,900 ft <sup>3</sup>	-	-
e	-	-	34,900 ft <sup>3</sup>	-	-
f	4,250 ft <sup>3</sup>	-	-	-	-
g	-	-	9,600 ft <sup>3</sup>	-	-
h	-	-	-	-	2,150 ft <sup>3</sup>
i	-	4,968	-	-	-
j	-	-	700 ft <sup>3</sup>	-	-
Total, Three Years	10,900 ft <sup>3</sup>	5,568 ft <sup>3</sup>	238,300 ft <sup>3</sup>	522 ft <sup>3</sup>	4,600 ft <sup>3</sup>

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8.0 QUALITY ASSURANCE PROGRAM

8.1 Program Design

CNSI's Quality Assurance (QA) Program is designed to insure that the systems or components developed by CNSI will perform satisfactorily in service. The QA responsibilities outlined below are specific to QA's involvement in the MOBILE SOLIDIFICATION SYSTEM. However they may be extrapolated to other safety related issues. CNSI's QA program meets the requirements of 10 CFR 50 Appendix B and 10 CFR 71 Appendix E.

8.2 Quality Assurance Responsibilities

8.2.1 Inspection Control

QA's inspection program for the MOBILE SOLIDIFICATION SYSTEM is designed to verify that quality related activities within the system conform to design or process requirements. Scheduled and unannounced inspections of field units are routinely performed by CNSI's certified QA inspectors.

8.2.2 Drawing and Document Control

QA confirms the adequacy and completeness of all Mobile Unit drawings, procedures and instructions. All changes to drawings or documents are subject to the same confirmation.

8.2.3 Purchased Material, Equipment or Service Control

QA performs preliminary evaluations of potential vendors and makes procurement source recommendations to CNSI's Mobile Solidification Design Group. QA also confirms that the supplied items or services conform to the procurement requirements.

8.2.4 Component & Material Identification and Control

QA confirms that the identification and control

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of purchased components, materials, parts or assemblies used within the MOBILE RADWASTE SOLIDIFICATION SYSTEM meet the established requirements. This applies to all phases of fabrication and installation.

8.2.5 Special Process Control

QA confirms that special fabrication, installation and inspection processes associated with the MOBILE SOLIDIFICATION SYSTEM are performed in accordance with the applicable CNSI requirements.

8.2.6 Test Control

QA's test control program confirms that tests associated with Mobile Unit's fabrication, checkout, operation and maintenance are performed.

8.2.7 Measuring and Test Equipment Control

QA confirms that equipment used for testing of Mobile Unit equipment is calibrated in accordance with MIL-C-45662, or that the alternate calibration method is documented.

8.2.8 Handling, Storage and Shipping Control

QA confirms that handling, storage and shipping requirements of any item related to the Mobile Unit, including the Unit itself, are satisfied.

8.2.9 Nonconformance Control

QA identifies, segregates and documents nonconforming materials, parts or processes dealing with Mobile Solidification Unit operation.

8.2.10 Corrective Action

QA continually monitors materials, processes or workmanship to insure nonconformance is corrected and documented.

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### 8.2.11 Audits

QA conducts system and procedure audits of quality-related issues to verify the effectiveness of CNSI's QA program in relation to the MOBILE RAD-WASTE SOLIDIFICATION SYSTEM.

## 9.0 RESEARCH AND DEVELOPMENT PROGRAM

### 9.1 Program Design

CNSI's Research and Development (R&D) program focuses on the investigation of specific techniques and materials which will improve the MOBILE RADWASTE SOLIDIFICATION SYSTEM. The results and conclusions from the ongoing research on the radwaste solidification process by the Department of Energy and numerous other research groups form the basis for CNSI to develop new approaches to the Mobile Radwaste Solidification concept. Significant changes in operational or design concepts are field tested to demonstrate their acceptability prior to implementation at an operating site.

### 9.2 Program Emphasis

R&D studies incorporate theoretical process analysis, laboratory analysis and field evaluations. Field and laboratory process analysis ranges from small sample testing to actual field simulations.

CNSI research on the Radwaste Solidification Process currently includes investigations of the following areas:

- a. the chemical compatibility of the solidification agents with the radwaste types
- b. the variations in urea formaldehyde resin formulations and their effect on solidification

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- c. alternate reaction catalysts
- d. optimal waste/solidification agent ratios for various liquid and resin wastes
- e. the correlation between hardness of solidified matrices and condensate generated during solidification
- f. antifoaming and defoaming techniques and chemicals.

The operating experience gained from field operation of the Mobile Solidification Unit led to the investigation of alternate equipment designs and operating sequences. Four areas of study were isolated and programs implemented to coordinate design with past operating experience:

- a. mixing systems and sequences including in-line, propeller and air sparging techniques
- b. level monitoring systems (CCTV Systems, Pneumatic, Ultrasonic)
- c. resin bead, powder and sludge dewatering techniques
- d. chemical analytic techniques for field use.

Investigations into these areas are ongoing. Laboratory scale studies are performed at the Corporate Engineering Facilities. Full scale solidification tests in 7 ft<sup>3</sup>, 50 ft<sup>3</sup>, 195 ft<sup>3</sup> and 300 ft<sup>3</sup> containers are performed at the Mobile Operations Center, Barnwell, S.C.

#### 10.0 POSTULATED ACCIDENT ANALYSIS

The CNSI Solidification System is designed, fabricated and operated in accordance with the applicable NRC and National

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Electric Code Standards. The operating and maintenance procedures are designed to insure that the risk of an accident is as low as possible. There is no risk of explosion, and the only source of fire is the electrical power and control system. Even in the event of an electrical fire, the fail-safe control system is designed to prevent leakage of radioactive materials or spread of the fire to non-electrical components.

The possibility of a release of liquid radioactive material exists during waste transfers to the waste container and while waste is being stored in the container prior to solidification. A line rupture during a waste transfer is considered to be the less serious of the potential accidents. The total curie content of the spilled material in a line rupture depends on the specific activity and the quantity of the waste material being transferred. In turn, the quantity of the waste material spilled depends on the flow rate and response time of the operator. Flow rates depend on the capacity of the facility transfer pumps, but flow rates of 50 gpm are typical, while maximum rates of 100 gpm can be realistically anticipated. The response time of the operator depends on how quickly the operator observes the failure and actuates the waste control valve. Once actuated, the waste control valve closes within 3 - 4 seconds. During a waste transfer, the operator is positioned at the control station, visually monitoring the transfer process. It is estimated that no more than two minutes would transpire prior to closing the waste control valve. A spill considering maximum flow rate and maximum response time, then, would generate about 200 gallons of liquid or resin slurry waste.

The estimated volume of waste spilled considering the rupture of a liner after both waste and solidification agent transfer to the liner is 2,100 gallons. Therefore, CNSI considers the maximum credible accident to be the rupture of a filled liner prior to solidification. A postulated accident analysis was performed using the following assumptions:

- a. The liner contains approximately 2,100 gallons of waste and solidification agent in liquid state at atmospheric pressure.

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- b. The iodine partition factor is 10,000 between the liquid and vapor phases once the liquid escapes from the liner.
- c. There is total escape of all noble gases upon rupture of the liner.
- d. The worst case  $\chi/Q$  is  $7.6 \times 10^{-4}$  s/m<sup>3</sup>.

The accident considered was the rupture of approximately 1/3 of the circumference of the liner's bottom weld (approximately 90 in. x 0.5 in. or 45 sq. in.). The liner was considered outside the facility's radwaste building. The results of this analysis were:

- a. escape rate of approximately 57 gallons per second
- b. time for liner to empty approximately 40 seconds
- c. maximum instantaneous radgas concentration at the site boundary (worst case only):

I-131	=	17% MPC
I-133	=	0.1% MPC
I-135	=	.04% MPC
Xe-133	=	0.1% MPC
Kr-88	=	11% MPC

## 11.0 APPLICABLE CODES AND STANDARDS

### 11.1 Operating Equipment

#### a. 10 CFR 20

Standards for protection against radiation.

(1) 10 CFR 20.1

Purpose

(2) 10 CFR 20.101

Exposure of individuals to radiation in restricted areas.

(3) 10 CFR 20.103

Exposure of individuals to concentrations of radioactive materials in air in restricted areas.

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d. Regulatory Guides

(1) R.G. 1.143

Design guides for radioactive waste management systems, structures, and components installed in light-water cooled nuclear power plants.

(2) R.G. 8.8

Information relevant to ensuring that occupational radiation exposures at nuclear power stations will be as low as reasonably achievable.

c. ANSI Standards

(1) ANSI B31.1

Power piping.

d. Military Standards

(1) MIL-C-45662

Calibration System Requirements

e. ASTM Standards

(1) E84

Test for surface burning characteristics of building materials.

11.2 Operating Procedures

a. 10 CFR 20

Standards for protection against radiation.

(1) 10 CFR 20.1

Purpose

(2) 10 CFR 20.101

Exposure of individuals to radiation in restricted areas.

(3) 10 CFR 20.103

Exposure of individuals to concentrations of radioactive materials in air in restricted areas.

(4) 10 CFR 20.201

Surveys (precautionary procedures).

(5) 10 CFR 20.203

Caution signs, labels, signals and controls.

(6) 10 CFR 50

Quality Assurance criteria for nuclear power plants and fuel reprocessing plants.

Appendix B

(7) 10 CFR 71  
Appendix E

Quality Assurance criteria for shipping packages for radioactive material.

c. CNSI Standards

(1) CNSI Procedure  
CN-AD-003

Document on procedure preparation.

11.3 System Processes

a. 10 CFR 20

Standards for protection against radiation.

(1) 10 CFR 20.1

Purpose

(2) 10 CFR 20.201

Surveys (precautionary procedures).

b. Regulatory Guides

(1) R.G. 8.8

Information relevant to ensuring that occupational radiation exposures at nuclear power stations will be as low as reasonably achievable.

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APPENDIX C

Chem-Nuclear Systems, Inc. Quality Assurance Program

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# CHEM-NUCLEAR SYSTEMS INC.

P.O. Box 1866 • Bellevue, Washington 98009 • (206) 827-0711

## QUALITY ASSURANCE PROGRAM

Prepared by: Bruno Linn  
Manager, Quality Assurance

Approved by: Louis E. Reynolds  
Director of Regulatory Affairs

Approved by: Bruce Johnson  
President, CNSI

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Assigned to: \_\_\_\_\_

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FOREWORD

This program defines and describes the basic policies and procedures used by Chem-Nuclear Systems, Inc. (CNSI) to establish quality assurance requirements for all activities affecting safety related functions of systems and components, including transport casks, of CNSI. The activities include designing, purchasing, fabricating, handling, shipping, storing, inspecting, testing, operating and using, maintaining, repairing and modifying. Chem-Nuclear Systems, Inc. top management has approved and fully supports adherence to the policies and procedures contained in this program.

It is intended that policies and procedures described in this program meet or exceed the appropriate requirements of ASME Boiler and Pressure Vessel Code Section VIII, ANSI N45.2-1977, 10CFR50 Appendix B, 10CFR71 Appendix E and MIL-Q-9858A. This program, in full or in part, is subject to review and comment by customer representatives.

Revisions or additions to the program will be made as necessary to conform to the current needs of the company. All revisions will be dated and referenced on the revision page in front of the program.

Copies of the Quality Assurance Program will be issued to the customer and government representatives, as required. Assigned copies of this program will be serialized and a record maintained showing the transmittal of each revision. Information copies of the program may be distributed without serialization and they will not be updated with revisions.

This program is reviewed in total by CNSI's management at least once a year to assure conformance to current practices and requirements.

The Quality Assurance (QA) Program for CNSI was established and implemented by the President of CNSI. The Q.A. Program has the full support of CNSI's management and all CNSI's employees shall adhere to its provisions.

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1.0 ORGANIZATION

The Quality Assurance organization within Chem-Nuclear Systems, Inc., consists of a Quality Assurance Manager with the overall responsibility for providing quality assurance of design, fabrication and operation. He has a staff of quality assurance personnel reporting to him, who are assigned to the following areas:

- A. Vendor inspection
- B. Engineering/Fabrication
- C. Field Operations
- D. Barnwell operations

The individual assigned to vendor inspection is responsible for audits and surveillance to assure CNSI that all vendor and/or subcontractor activities are conducted in accordance with a written program that addresses the applicable criteria of CNSI's Quality Assurance Program.

Quality assurance for engineering/fabrication is responsible for auditing the CNSI's Engineering group to verify that all equipment has been designed, fabricated and tested in accordance with the established CNSI's procedures.

Quality assurance for field operations has the responsibility for audit performance of all CNSI's field operations. The audit includes verification of field unit operation in accordance with prescribed procedures and instructions.

The individual assigned to Barnwell operations is responsible for auditing the operation (use) and maintenance of casks licensed pursuant to 10CFR71 and the performance of applicable quality control checks on the casks. He also has the responsibility for auditing the rolling stock maintenance and health physics activities performed at Barnwell.

All quality assurance personnel report directly to the Quality Assurance Manager. The Quality Assurance Manager reports to the Director of Regulatory Affairs of Chem-Nuclear Systems, Inc. (see Figure 1-1).

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This reporting route has been selected specifically to allow the Quality Assurance Manager authority and independence required to implement and direct CNSI's Quality Assurance program, effectively assure the conformance to quality requirements, and to provide independence of undue influences and responsibilities for schedules and costs (see Figure 1-2).

The Quality Assurance Manager shall be free of non-Q.A. duties in order to give full attention to the Quality Assurance Program. Quality Assurance personnel shall be free to perform the following functions effectively and without hindrance or reservation:

- a. Identify quality problems, stop unsatisfactory work, and to control further processing, delivery or installation of nonconforming material.
- b. Initiate, recommend and provide solutions through proper channels.
- c. Verify implementation of solutions.

Position descriptions of the Quality Assurance Manager and all Quality Assurance personnel shall include prerequisite experience and/or required training, which assures that they are competent to perform the assigned duties.

While other organizations may be delegated the tasks of establishment and execution of a quality assurance program, it must be recognized, that the responsibility for equipment owned and operated by CNSI is retained by CNSI. The Quality Assurance Manager, upon notification of need for further direction or resolution of Q.A. problems, has the authority to communicate or direct communications with any contractor doing business with CNSI. Ordinarily, such communications will be through the branch of CNSI having responsibility for the function provided by the contractor involved.

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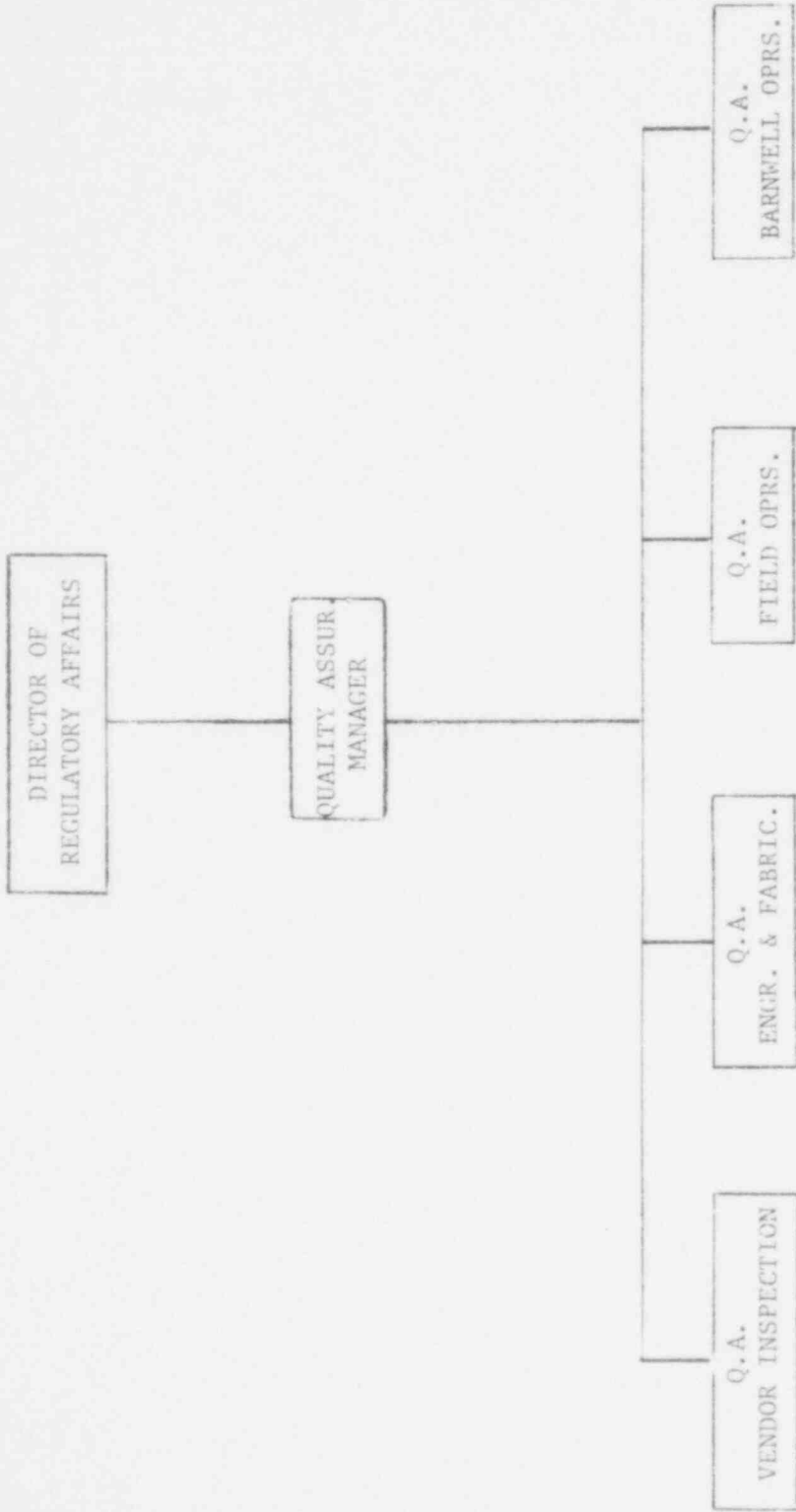


FIGURE 1-1

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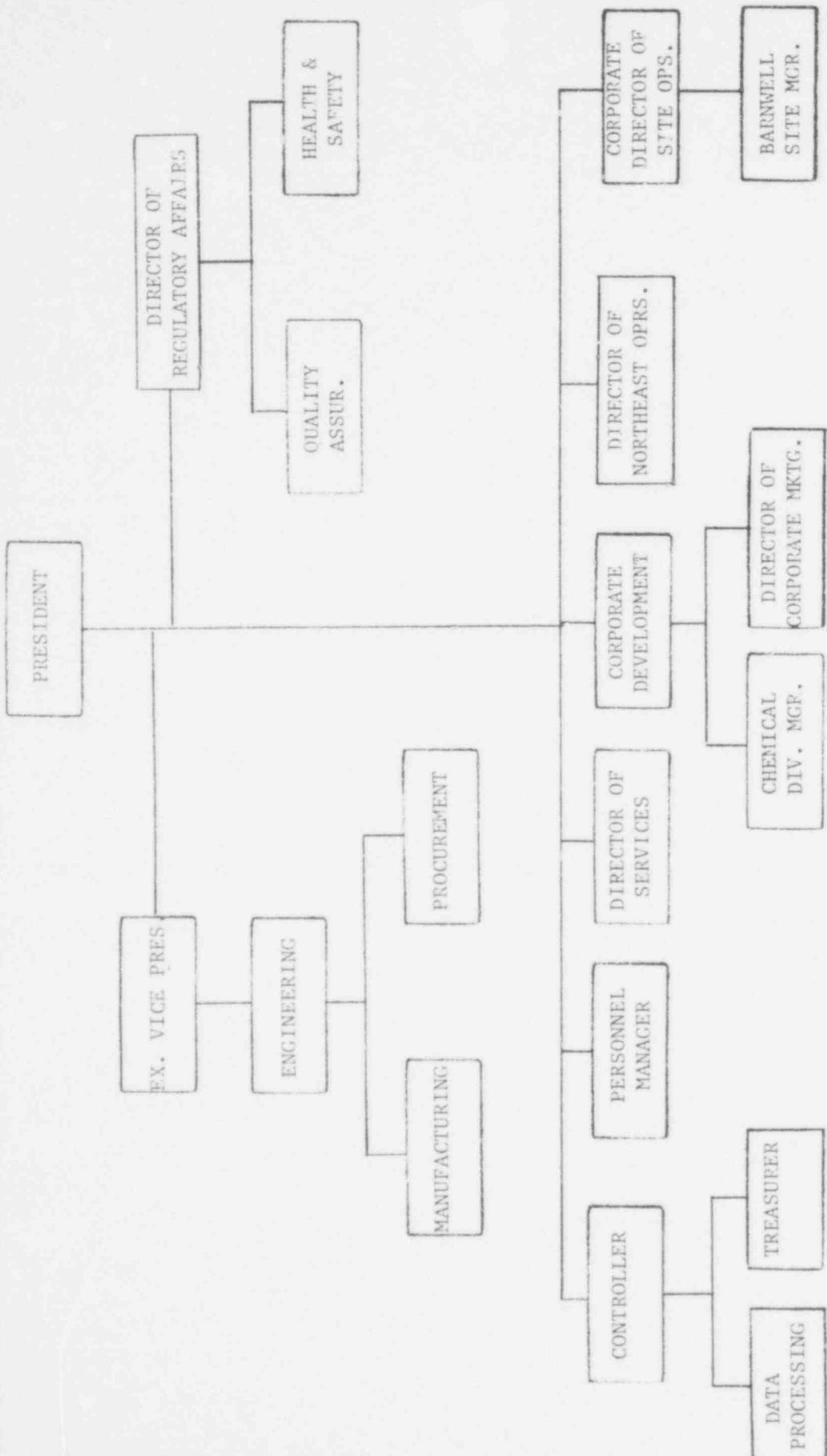


FIGURE 1 - 2

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2.0 QUALITY ASSURANCE PROGRAM

The Quality Assurance Program is comprised of those planned and systematic actions necessary to assure adequate confidence that all Chem-Nuclear activities will be conducted in a satisfactorily in service. It is the intent of this program to insure that all activities are conducted in a manner that has the degree of reliability on which safety and performance of these activities were evaluated. The Quality Assurance Program of CNSI applies to the following systems and functions:

- Solidification
- Demineralization
- Decontamination
- Transportation of radioactive materials.
- Engineering services provided to the nuclear industry.
- Radioactive waste burial.
- Health Physics services.

2.1 Management

In order to assure effective implementation, assess the scope and status, and determine the effectiveness of the Q.A. Program; the President of Chem-Nuclear has appointed a member of Senior Management, with broad authority, to execute these functions. Programmatically, these functions are executed through the use of internal audits, field investigations, customer/user service reports and internal reporting procedure.

2.2 Quality Assurance Personnel Qualifications

The personnel assigned to perform quality assurance functions with respect to those activities conducted by contractors are trained and qualified to perform those functions in accordance with ANSI/ANS-3.1-1978 and SN-TC-1A. Records of training and qualification of all certified personnel are maintained in company record files.

2.3 Quality Assurance Policies, Goals and Objectives

It is the policy of Chem-Nuclear that all activities which are governed by the Code of Federal Regulation, license, Certification of Compliance,

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Letter of Approval or other regulatory requirements, be conducted in accordance with written, approved procedures which incorporate the regulatory requirements in a manner which is easily understood by the user/operator. Adherence to the procedure requirements is mandatory for all Chem-Nuclear employees. All procedures which are required to assure regulatory compliance or health and safety are required to be submitted to the Safety Review Board for approval prior to implementation.

It is the stated goal and objective of the Chem-Nuclear Quality Assurance Program to provide those mechanisms and environments necessary to achieve a reliable Quality Assurance Program for all activities which affect health and safety or are specified by a regulatory requirement. This goal and objective is promulgated throughout the company through the use of written procedures, management memoranda and management/staff meetings.

Differences of opinion between QA/QC personnel and other CNSI departments shall be resolved in a meeting of the Safety Review Board.

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3.0 DESIGN CONTROL

Design control at CNSI consists of a laddered review system (Figure 3-1 and Table 3-1). This independent design review and drafting check is geared towards the following criteria:

- a. drawing accuracy and precision
- b. design review in terms of the applicability of the design to standard codes and regulations and the actual mechanics and feasibility of the design itself.

The project engineer is responsible for:

- a. the initial interpretation of the design specifications in relation to regulatory codes and standards
- b. interfacing activities of all associated parties, including the final approval of the quality assurance division.
- c. insure that all critical environmental, radiological and chemical design considerations are incorporated into the actual engineering design package
- d. design and implementation of any design testing

The drawing control coordinator is responsible for control of the engineering drawing system. Document release and distribution from the engineering department is supervised by the drawing control coordinator in order to assure all approval signatures are on the drawing, the latest revision level is being distributed, and the file on document distribution is continually updated.

Quality Assurance reviews the engineering design packages for inclusion of the applicable quality standards in the design documents.

For certain systems and equipment used in nuclear work (transport casks, etc.) an independent verification of design is accomplished by an outside contactor or by other company employees not under the supervision of the original designer or his supervisor. The verification includes a determination that valid industry standards and specifications have been selected.

Design changes must follow engineering departmental procedures. Design changes are subject to the review steps listed in Figure 3-1.

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Errors and deficiencies in design, including the design process that could adversely affect safety shall be documented and corrective action taken to preclude repetition.

Materials, parts and equipment which are standard commercial (off the shelf) or which have been previously approved for a different application must be reviewed for suitability to any new application.

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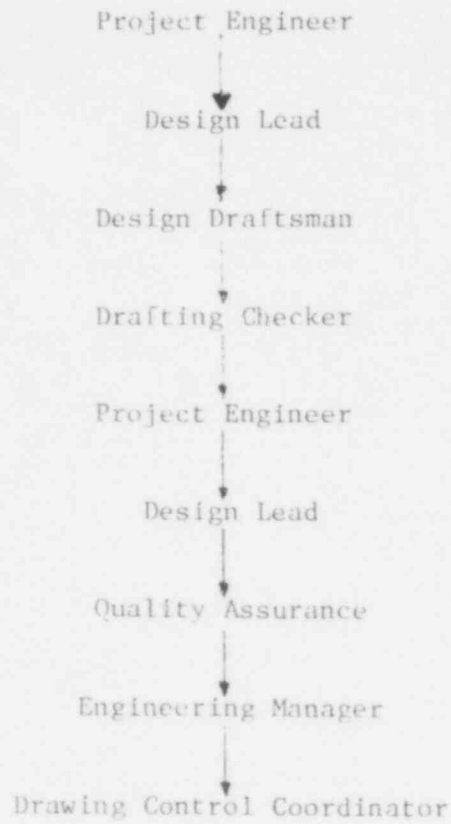
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FIGURE 3-1  
ENGINEERING DESIGN CONTROL LADDER



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TABLE 3-1  
INDIVIDUAL REVIEW RESPONSIBILITIES  
FOR ENGINEERING DESIGN CONTROL

Project Engineer	<p>Confirms overall design package meets applicable codes and regulations.</p> <p>Confirms accuracy of technical aspects of the design package.</p>
Design Lead	<p>Oversees design drafting.</p> <p>Confirms that all parts and equipment conform to the design specifications.</p> <p>Confirms fit, function, producability of system.</p> <p>Liason between drafting, quality assurance and the project engineer.</p>
Design Draftsperson	<p>Produces design drawings per project engineer's specification.</p> <p>Responsible for fit and function of unit per design engineer specifications.</p>
Drafting Checker	<p>Performs a non-technical check of design.</p> <p>Confirms accuracy and precision of drawing in all aspects of drafting techniques.</p>
Quality Assurance	<p>Reviews specification of quality standards in design documents. Assures design characteristics can be controlled, inspected and/or tested.</p>
Engineering Manager	<p>Confirms total design package is ready for release.</p> <p>Confirms equipment meets customer requirements.</p>

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4.0 PROCUREMENT DOCUMENT CONTROL

The procurement of materials, components, services at, or services affecting assemblies, for use of utility customer sites or other licensed activities is accomplished with a written Purchase Order. Purchase Order forms are controlled, and in the possession of a limited number of individuals. Only these individuals are authorized to release Purchase Orders, and are responsible for conforming with established procurement and record keeping procedures. The sequence of events leading to Purchase Order issuance, and the associated record keeping activities, are in compliance with procedures published in ANSI N45.2.13.

It is CNSI's policy that Purchase Orders, except for administrative supplies, are written from requisitions that are reviewed by the cognizant department/site manager and, at his direction, an individual certified by the Quality Assurance Manager. Where the department/site manager determines that the procurement action is governed by an applicable standard, specification, code, regulation, license or Certificate of Compliance, the requisition is submitted to the Quality Assurance Manager or his designee for review and approval.

The Quality Assurance reviewer examines the requisition, amending it as necessary, to ensure that complete information is provided to identify:

- a. The applicable 10CFR Part 50, Appendix B and 10CFR71, Appendix E requirements which must be complied with.
- b. The design basis technical requirements including the applicable regulatory requirements, material and component identification requirements, drawings, specifications, codes and industrial standards, tests and inspection requirements, and special process instructions.
- c. The documentation to be prepared, maintained, and submitted to the purchaser for review and approval.
- d. The records to be retained, controlled, and maintained by the supplier, and those delivered to the purchaser prior to use or installation of the materials or components.
- e. The procuring agencies right of access to suppliers facilities and records for source inspection and audit.

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- f. That the quality requirements are correctly stated, inspectable and controllable with adequate acceptance and rejection criteria stated.
- g. The procurement document has been prepared and reviewed in accordance with QA program requirements.

The individual authorized to control and release Purchase Orders, upon receipt of a requisition with all necessary reviews and approvals, writes the Purchase Order incorporating all information contained in the requisition. One copy of all Purchase Orders is maintained in a control file.

Procurement documents for spare or replacement parts shall be subject to the same controls that are applied to the original equipment. Changes and revisions to procurement documents are subject to the same review process as original documents.

Original and revised procurement documents shall be clearly annotated to indicate the completion of the aforementioned review and approval sequence. Record copies shall be maintained in accordance with document control procedures in effect at time of preparation.

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5.0 INSTRUCTIONS, PROCEDURES AND DRAWINGS

Activities affecting product quality in design manufacturing, operation, and maintenance are prescribed by documented instructions, procedures or drawings of a type appropriate to the circumstances. They include quantitative and/or qualitative acceptance criteria for determination that the prescribed activities have been satisfactorily performed. The activities are accomplished in accordance with the instructions, procedures or drawings.

The purpose of the instructions, procedures and drawings as described herein, is to provide and communicate standards for the quality determination within the company, to the vendors and to the customers and are directed at maintenance of overall quality program. These instructions are available for review by customer representatives.

Procedures and instructions are prepared by the cognizant department. All instructions and procedures are maintained current with a documented method of revision. Instructions, procedures and drawings are readily available to personnel at locations requiring their use.

The drawings, instructions and procedures detail, where applicable, any equipment, environmental conditions and the exact method to be used to determine the condition of the item under examination. Prerequisite calibration of all special test equipment is clearly stated in detail. All acceptance criteria is clearly defined. If visual aids or standards are available and applicable, they are referenced in drawings, instructions and procedures.

The CNSI's Quality Assurance organization reviews and concurs with inspection plans; test, calibration and special process procedures, drawings and specifications and their changes, and verifies that methods for complying with regulations, such as Code of Federal Regulations (10CFR50, 10CFR71) are specified in instructions, procedures and drawings requiring such verifications.

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CNSI's Q.A. organization shall review instructions, procedures and drawings to ensure that adequate quantitative and qualitative acceptance criteria are present.

The CNSI's Procedure for Document Preparation shall be followed exactly in the course of preparation, review, approval and control of instructions and procedures. Drawings shall be prepared, reviewed, approved and controlled in accordance with engineering department procedures.

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6.0 DOCUMENT CONTROL

The document control system at CNSI provides controls for drawings, specifications, procedures, instructions and their respective changes to assure adequacy, completeness and meeting the intent of such documentation.

6.1 Document Types Controlled

The control includes all documents and their changes affecting the quality program. These documents include, but are not limited to, design drawings and specifications, manufacturing drawings, procurement documents, quality assurance manuals, manufacturing, inspection, operating and testing instructions, test procedures and design change requests. The control system provides adequate and timely distribution of all documents to recipients listed on a document distribution list and prompt removal of all obsolete documentation from defined document control centers.

6.2 Document Review

All design drawings, design procedures and specifications are issued by Engineering. They are reviewed and approved by Quality Assurance for adequacy and compliance with applicable quality standards and/or contractual requirements. The review assures the availability of all information required to produce an article in complete conformity with design requirements. The review process is the same for document changes.

All procedures and instructions are reviewed by CNSI's Quality Assurance. Non-safety related documents are approved by the cognizant department or site manager. All safety related documents are reviewed and approved by CNSI's Safety Review Board.

6.3 Document Control

Execution of an effective document control system requires the following:

- a. Each document shall have an identifying number and a complete descriptive title.

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- b. Each document shall have means for identifying the revision status and the effective date of each revision.

The number of copies made and issued of a document is controlled by a document distribution list maintained in the document file. This list facilitates retrieval of obsolete or modified copies of the document. The removal of obsolete documents, procedures, details, forms, etc., is accomplished immediately when such material is made obsolete by a new or revised document. The removal is effected promptly after release of the new or revised document. Obsolete documents are destroyed except for a history copy maintained in the document file.

Procedures and their changes are distributed on a formal basis and are of standard format. In cases of emergency, however, approved handwritten procedures or marked-up changes can be considered satisfactory as long as they are converted to the standard form and become official within 30 days.

Drawings and/or documents sent to a customer or subcontractor are accompanied by a document transmittal letter showing the drawing and/or document number, revision and date of transmittal. A copy of the transmittal letter is kept in the project file.

Purchase orders used on manufacturing type projects are changed to indicate the effect of engineering changes. On completed projects, a list of as-built drawings and documents are maintained in project control file to define the documents to which the item was built.

#### 6.4 Document Change Control

All changes to documents, specifications and procedures are made utilizing the Change Order form. The form is a one-part reproducible form used to specifically delineate a proposed change. The form is also used for submission of proposed changes to customers when

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their approval is required prior to change incorporation.

All proposed changes are reviewed by Quality Assurance prior to their approval to determine the effect of the change on the quality of the article and the resultant changes in inspection, procedures or operations. Revisions, changes and modifications of affected documentation is made only after approval of the applicable change order. All approved change documents are attached to the document revised or changed and are incorporated in the document upon completion of the project or sooner. All the aforementioned instruments for effecting a change require a definition concerning when the change becomes effective. All drawing changes are reviewed by Engineering at the time of project completion for updating original drawings to an "as built" configuration.

6.5 Document Control for Subcontractors

Subcontractors and vendors are required to maintain an effective drawing change control system when these drawings are provided as part of the contractual requirements.

Procurement of articles to CNSI's design requires a document control system that includes assurance of notification of changes to the subcontractor or vendor, verification of change incorporation and appropriate identification of those items on which the change is incorporated.

Procurement of articles of subcontractor's design requires a document control system that assures notification of CNSI by the subcontractor of the proposed change, approval of the change by CNSI and appropriate identification of the items on which the change is incorporated.

6.6 Document Availability

Documents will be available at the locations where activities involving them are to be performed prior to commencement of work.

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7.0 CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES

The procurement control methods CNSI uses establish measures to assure that procured items and/or services are clearly and adequately specified in procurement documents and are supplied by vendors and subcontractors who are capable of producing items and furnishing services, which conform to procurement document requirements. These procurement control methods, which consist of procedures or instructions, include provisions for vendor evaluation, review of procurement requirements and surveillance of vendor's facility.

7.1 Vendor Evaluation

Evaluation of procurement sources is performed by CNSI's engineering procurement and quality assurance personnel. Recommendation of procurement sources is based on these evaluations. Results of supplier evaluations performed prior to contract award are documented and filed. The evaluations cover review of capabilities and facilities for technical, manufacturing and quality performance, and include any or all of the following as appropriate:

- a. historical performance data, particularly in product quality and delivery
- b. review and comment on supplier's quality assurance program
- c. source audits to verify supplier's implementation of his quality assurance program, as required
- d. source qualification programs.

The evaluation considerations include the elements of the NRC's Quality Assurance Criteria to the extent these criteria are applicable to the equipment being procured. Actions to correct deficiencies in the supplier's organization or quality program are resolved with the supplier's management prior to fabrication of ordered items.

7.2 Procurement Requirements

Requirements to be met by the supplier are detailed in the procurement documents which include procurement specification. This

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document details the aspects of supplier quality assurance, for example, inspection reports, provisions for inspection, equipment calibration prior to use, and provisions for inspection after component repair. The procurement specification also requires the successful bidder to submit the following for CNSI's review:

- a. special process procedures for performing welding, heat treatment, nondestructive examination
- b. recommended inspection point program
- c. appropriate documentation as required by applicable codes, standards and procurement documents
- d. notices of non-conformances and deviations
- e. test procedures in accordance with applicable codes and standards.

### 7.3 Vendor Surveillance

CNSI's Quality Assurance has the following typical responsibilities for supplier surveillance:

- a. witness test inspections and nondestructive examinations and audit of the various special process operations
- b. surveillance and audit of heat treatment, welding, cleaning, preserving, packing and packaging activities
- c. audit supplier conformance with established procedures, such as:
  1. use of CNSI accepted drawings and procedures
  2. use of accepted product and process quality planning
  3. document change control
  4. material identification and traceability control
  5. control and calibration of measuring equipment
  6. control of major repair welding
- d. review of completed product quality checklists and release tags prior to release of equipment for shipment.

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Documentation of nonconformances shall be provided by suppliers as prescribed in Section 15 of this program.

CNSI's quality assurance personnel perform a review of supplier documentation during in-process, testing and final inspection stages. The entire documentation package is reviewed prior to shipment of manufactured items. This documentation includes material test reports, inspection and test reports, NDE reports and applicable code data reports.

The frequency and extent of the surveillance are consistent with the importance to safety, complexity, and quantity of the item or service being furnished. The measures to evaluate the effectiveness of the control of vendor quality are described above. The surveillances are in accordance with an inspection point program prepared by CNSI. The inspection point program includes manufacturing and testing activities to be witnessed, quality assurance activities to be confirmed by surveillance, and the review of the required documentation.

Receipt inspections shall be performed on all purchased items (including spare or replacement parts) to assure.

- a. That material, component or equipment is properly identified and corresponds to the identification on receiving documentation.
- b. That material, components, equipment and acceptance records are inspected and judged acceptable in accordance with predetermined inspection instructions prior to installation and use.
- c. Inspection records or certificates of conformance attesting to the acceptance of material, components and equipment are available and are filed in the project file prior to use.
- d. Items accepted and released are identified as to their inspection status prior to forwarding them to a controlled storage area or releasing them for installation or further work.

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8.0 IDENTIFICATION AND CONTROL OF COMPONENTS AND MATERIALS

The identification and control as described herein shall apply to components, production materials, bulk raw materials, parts and assemblies at all stages of fabrication and installation from receipt of components and material to completion of the system or component supplied. These requirements shall be imposed on CNSI's subcontractors and suppliers.

8.1 Components and Materials

The inspection status of all components and material shall be evident at all times. This shall be accomplished by marking, tagging or stamping components or material and the stamping of work orders or material requests accompanying them at the appropriate stages of fabrication or installation.

Identification of components and material with an identification number shall be accomplished with a method that will provide legible identification as permanent as the normal life expectancy of the item marked, without adverse effect on its life and utility.

Components or material not suitable for individual marking, shall be individually tagged or shall be placed in an identified container.

The storeroom shall accept only components or material which have been inspected and accepted. The Inspection shall maintain surveillance over the storage areas to assure that materials subject to matching material certification control or age limit requirements are properly segregated, dated and controlled. This surveillance shall also include checking for conformance to proper standards of packaging and storage of all stored components, material, parts and assemblies.

8.2 Bulk Raw Material

Following the acceptance of bulk raw materials, a tag showing the purchase order, the material identification, mill heat number or heat code and the date of receipt shall be fastened to the material.

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If during fabrication all identification has been removed from the part of the material being used, the remnant shall be marked before returning to stock.

Material marking shall be such that it shall not be affected by contact incident to normal handling, exposure to the elements, shipment or storage. All markings shall offer ready readability and prompt identification of the material. Physical marking of materials shall be accomplished in a manner which will not adversely affect the machining, forming or fabrication of the material. Impression printing shall not be used.

Identification requirements shall be determined during generation of specifications and design drawings. Identification of materials and parts for safety related systems or components shall be traceable to the appropriate documentation, such as drawings, specifications, purchase orders, manufacturing and inspection documents, deviation reports and physical and chemical mill test reports.

Prior to release for fabrication, assembling, shipping and installation the correct identification of material, parts and components must be verified and documented.

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9.0 CONTROL OF SPECIAL PROCESSES

All special fabrication, installation and inspection processes which could have an effect upon the quality of the component, system or fabrication operation shall be controlled by process procedures.

9.1 Personnel Certification

Personnel responsible for performance, inspection and control of special processes and operations which require special skills and could have an effect upon quality shall be certified. Certification of personnel for these processes or operations (such as welding, heat treating and nondestructive testing) shall include a formal training program followed by a formal testing procedure to assure the proficiency of each individual. Personnel certification requirements shall conform to the applicable codes and standards, such as, ASME Section IX for welding and heat treating and SNT-TC-1A for nondestructive testing. The period of effectivity for all certifications shall be specified and each individual shall be re-certified at the end of such period through re-testing. Persons failing the re-test shall be removed from operations and shall be provided with additional training as required for re-certification. Inspection results and quality audits shall be used as indicators of the need for additional training and recertification of fabrication, installation and inspection personnel without regard for established re-certification periods. Personnel shall also be re-certified in accordance with the applicable standard. A record of the names of certified personnel their skills and certification periods shall be maintained by Quality Assurance.

9.2 Subcontractor Control

Special processes performed by CNSI's subcontractors and suppliers shall be specified in procurement documents and shall be monitored by Quality Assurance for conformance with CNSI requirements. A certificate of compliance shall be required from all subcontractors and suppliers performing special processes.

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9.3 Procedures

Special process procedures shall be reviewed and approved by Quality Assurance which conducts an audit function to assure that the approved procedures are adequately followed. Process procedures shall include the method required for periodic verification of adequacy of the processing materials, solutions, equipment and their associated control parameters and the recording of the inspection results and process verifications performed.

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## 10.0 INSPECTION

The established inspection program at CNSI verifies the conformance of quality related activities with the applicable requirements. The verification is performed in accordance with written inspection procedures or instructions. Personnel performing the inspection are independent from the individuals performing the activity being inspected. The inspectors are qualified in accordance with applicable codes and standards and their qualifications and certifications are kept current.

Equipment modifications, repairs and replacements are inspected in accordance with the original design and inspection requirements unless an approved alternative exists. Provisions for mandatory inspection hold point identification requiring witnessing by an inspector are incorporated in the appropriate documents, such as, procurement specifications, test procedures, etc.

The inspection program also provides for identification and documentation of deficiencies discovered during inspection and the required corrective action.

### 10.1 Inspection Procedures

Inspection procedures and instructions are written documents which provide the following information:

- A. Identification of characteristics and/or activities to be inspected.
- B. Identification of the individual or group responsible for performing the inspection.
- C. Acceptance and rejection criteria.
- D. A description of the inspection method.
- E. Recording evidence of completing and verifying a manufacturing, inspection, or test operation.
- F. Recording inspector or data recorder and the results of the inspection operation.

Inspection procedures and/or instructions are used in conjunction with the specified specifications or drawings when inspection operations are performed. Inspection procedures are maintained current by established document control measures.

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10.2 Supplier Inspection

CNSI identifies inspection requirements in procurement documents issued to subcontractors and suppliers. The subcontractors and suppliers are responsible for inspection of their products and CNSI's Quality Assurance verify their controls to assure adequacy of inspection. Supplier's inspection plans are required to recognize those CNSI notification or hold points specified by procurement documents for witnessing by CNSI.

10.3 Indirect Control

In the event that direct inspection is not possible, indirect control of the inspection process shall be provided through monitoring processing methods, equipment and personnel where applicable.

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## 11.0 TEST CONTROL

A test control program established at CNSI assures that all required testing is identified and performed in accordance with written test procedures, which incorporate the requirements and acceptance limits specified by the applicable design documents.

### 11.1 Test Procedures

Test procedures are prepared by Engineering and reviewed by Quality Assurance in accordance with standards, procedures or instructions that require inclusion of the following quality assurance requirements, as applicable:

- A. Requirements and acceptance limits as contained in the applicable design documents.
- B. Detailed instructions for performing the test.
- C. Test prerequisites, including, but not limited to the following:
  - a. calibrated instrumentation
  - b. adequate and appropriate equipment
  - c. trained, qualified, and as appropriate, licensed and/or certified personnel
  - d. preparation, condition and completeness of the item to be tested
  - e. suitable and, if required, controlled environmental conditions
- D. Mandatory inspection hold points for witness by responsible individual.
- E. Acceptance and rejection criteria.
- F. Method for documentation or recording of test data and results.

Test procedures shall be subject to document control as outlined in Section 6 of this program. They shall be maintained current by revisions issued upon changes in specifications, documentation, drawings or contracts.

### 11.2 Test Records

Records of tests performed shall be prepared, showing the applicable drawing or procedure revision, identification of test performed and date; with test data and other essential test information recorded.

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The test record shall be signed by individual performing the test and any test witnesses, if so required. Test records shall be maintained by Quality Assurance.

11.3 Test Control for Procured Items

Test control requirements are imposed on suppliers by procurement documents. They identify the tests to be performed and provide for suppliers' test procedure submittal for approval. Tests are conducted by groups within the supplier organization considered acceptable during supplier selection, and test control systems are audited during Quality Assurance surveillance. Also, records of tests are reviewed for acceptability during surveillance, and this review includes consideration of the qualifications of the supplier group making acceptance disposition of test results.

11.4 Modifications, Repairs and Replacements

Modifications, repairs and replacements shall be tested in accordance with the original design and test requirements or acceptable alternatives approved in the same manner as the original.

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12.0 CONTROL OF MEASURING AND TEST EQUIPMENT

Measuring and test equipment with the necessary range and accuracy shall be provided to qualified personnel for the inspection, test and acceptance of material, parts, components and systems. Equipment accuracy shall be assured by calibration traceable to national standards or the alternative basis for calibration shall be documented. Equipment calibration shall be based on the requirements of MIL-C-45662.

12.1 CNSI's Equipment Calibration and Control

All inspection and test equipment shall be subjected to maintenance and calibration at periodic intervals by qualified personnel or sub-contractors. Frequency of calibration shall be based on the equipment type, historical experience and operational requirements.

Each item of measuring and test equipment shall be serialized for record and identification purposes. A sticker shall be attached to the equipment to indicate date of calibration, due date of next calibration and the stamp or signature of the person conducting the calibration. A status file shall be maintained for all calibratable equipment.

Measuring and test equipment shall be issued to and retained between calibrations by those requiring its use. Each user has the responsibility to ascertain, prior to use, that the measuring and test equipment calibration date has not expired and that damage or rework has not taken place since the last calibration. Compliance with the above requirements is monitored by Quality Assurance.

12.2 Measuring and Test Equipment at Subcontractors

Measuring and test equipment used by subcontractors, vendors and suppliers engaged in fabricating and furnishing materials, parts and components to CNSI shall be under the surveillance of CNSI's Quality Assurance. Surveillance activity include checks to assure that inspection operations are or have been performed with appropriate measuring and test equipment, currently adjusted and calibrated against national standards. Where no national standards for equipment cali-

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bration exist, the documentation for the basis of calibration is audited. The surveillance shall cover production tooling, jigs, fixtures and other fabrication equipment which controls dimensions, contours, etc., and which is used for acceptance.

12.3 Inspection Validity

When measuring and test equipment is found to be out of calibration, measures shall be taken to ensure the validity of previous measurements and tests conducted during the period when the equipment is likely to have been operating in such a condition.

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13.0 HANDLING, STORAGE AND SHIPPING

13.1 Procured Items

Measures used to control packaging, shipping, storage and handling of components and material to prevent damage or deterioration shall be documented to reflect contractual or CNSI specified requirements. Procurement documents shall identify the required control measures to suppliers.

The supplier must have adequate written work and inspection instructions for storage, preservation and packaging of shipment to protect the products from damage, loss, deterioration or substitution. As required by the equipment specification and/or procurement documents, these procedures may be subject to approval by CNSI.

13.2 Transport Casks

Transport cask handling and operation shall conform to the written handling and operation procedure for each licensed cask.

Prior to the shipment of a transport cask all conditions of the NRC's Certificate of Compliance (specifications, tests, inspections) shall be satisfied. All required shipping papers shall be prepared and shall accompany the shipment.

Quality Assurance through the Q.A. personnel located at Barnwell, S.C. is responsible for auditing all critical cask handling, storage and shipping operations conducted by Barnwell Site Operations personnel.

Established safety restrictions concerning handling, storage and shipping shall be included in the handling and operating procedures for transport casks.

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14.0 INSPECTION, TEST AND OPERATING STATUS

14.1 Equipment Status

The inspection, test and operating status of systems and components used for processing or transportation of radioactive materials shall be known at all times during manufacturing and use.

Transportation and operating procedures shall include reporting requirements which establish the equipment status at key events (after unloading, prior to shipment, etc.).

Equipment status will be maintained by Barnwell Site operating personnel who are responsible for critical inspection, test and operating activities. Barnwell site quality assurance personnel shall verify equipment status and compliance with procedures. Bypassing of required tests or other critical operations shall be procedurally controlled under the cognizance of Barnwell's quality assurance personnel with the concurrence of the Q.A. Manager.

14.2 Establishment of Examinations and Tests

In-process and final examinations and tests shall be established to assure conformance with documented instructions, procedures, drawings, rules and regulations.

14.3 Hold Points

The procurement documents, drawings, quality plans, transportation and operating procedures shall establish any required mandatory hold points in the receiving, fabrication testing and operational sequence which shall be reflected in fabrication or operational schedule. Hold points shall be designated points in the fabrication or operation schedule beyond which the operations shall not proceed without consent of quality assurance because of witnessing, examination or testing requirements.

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14.4 Check Lists of Examinations, Tests and Inspections

Prepared check lists shall include the document number and revision to which the examination, inspection or test shall be performed. The check list shall have space provided for recording results of examination, test or inspection and for witness signatures, initials or stamp and date for activities witnessed.

14.5 Examination or Process Status

Measures shall be established to indicate during receiving, fabrication and equipment operation the status of examinations and test performed upon items, systems and components by use of markings that are attached to, remain with, or are traceable to the material, item, systems and components such as stamps, tags, labels, routing cards or other suitable means. These measures shall provide identification of those items which conform to examination and test requirements and those that do not conform.

14.6 Inspection Stamps

CNSI inspection stamps shall be applied to material, item, system, component or the controlling documentation to indicate the inspection status and to provide traceability to the individual performing the inspection.

The appropriate inspection stamp shall be normally applied directly to the item which has been accepted by inspection, material which has been accepted for limited use, and to material which has been rejected and dispositioned as scrap. When size, material or finish, etc., preclude stamping the material, a tag shall be attached to the item and appropriately stamped to indicate the status.

14.7 Control of Inspection Stamps

Inspection stamps shall be serialized for traceability to the individual inspector. Quality Assurance shall control and issue inspection stamps, as required, to authorized personnel. Records of individual issue shall be maintained and audits shall be periodically

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performed to assure legibility and proper ownership. Stamps removed from service because of loss, employee termination, etc., shall be retired for a minimum of three months.

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15.0 NONCONFORMING MATERIALS, PARTS OR COMPONENTS

Procedures for control of nonconforming materials, parts or components assure that such materials are adequately identified and segregated from acceptable materials, if feasible, to preclude their inadvertent use. Corrective action shall be initiated when a nonconformance is determined to be due to an assignable cause. CNSI's services and operations shall also be subject of nonconformance procedures when applicable.

15.1 Identification and Segregation

Materials, parts and components which are determined to be discrepant shall be identified with a tag and a numbered Nonconformance Report and physically separated from acceptable items. The method of identification shall clearly describe the nature and probable cause of the defect and indicate whether the defective item is to be repaired, reworked, scrapped or is to be subject to material review for determination of final disposition. Copies of the Nonconformance Report shall be forwarded to the appropriate departments for disposition. A holding area with controlled access shall be provided when required for material and/or component segregation. The Nonconformance Report shall indicate the nature and extent of the discrepancy and the disposition. Minor discrepancies that can be reworked shall be identified by an Inspection Tag until rework has been satisfactorily accomplished.

15.2 Subcontractor Control

Subcontractors shall promptly notify CNSI of all deviations from the procurement requirements, such as, deviations from the required codes or approved drawings. A nonconformance notice shall be initiated by the subcontractor in accordance with subcontractor's quality manual. Further fabrication operations on the material or component after detection of the deviation shall not be performed until it has been resolved by the subcontractor and CNSI. The subcontractor shall maintain records of each rework requirement, including the subcontractor's labor and material costs for each rework.

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15.3 Verification of Rework or Repair Acceptability

Rework or repair of materials, parts, components or systems shall be verified by reinspection and/or retesting the item as originally inspected and/or tested or by a method which is approved by established review procedures as at least equal to original inspections and/or tests. Inspection, testing, rework and repair procedures shall be documented and filed in the appropriate project files of CNSI.

15.4 Nonconformance Disposition

Final disposition of nonconformance shall be documented by CNSI's Q.A. personnel and shall be filed in the project file associated with the procurement of such material.

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16.0 CORRECTIVE ACTION

The corrective action program has means for determining the need for corrective action, documenting the need and the action taken, follow-up on the action for effectiveness, and reporting the need and action taken to the appropriate management personnel. Quality Assurance shall continuously monitor materials, processes and workmanship to assure a timely detection and correction of detrimental trends which could result in nonconforming products.

16.1 Correction of Nonconformities

Corrective action shall be initiated when it is determined that an existing nonconformity in a material, a process or a product is due to an assignable cause and is repetitive in nature. The request for corrective action shall be initiated at the earliest possible point; for example, when the request for corrective action is a result of repetitive rejections, the request shall be initiated at the time material disposition is made.

The corrective action procedure is divided into five basic steps:

- (a) Investigate discrepancy
- (b) Determine cause
- (c) Define corrective action
- (d) Implement corrective action
- (e) Evaluate corrective action

Specific individuals from appropriate departments shall be assigned the responsibility of accomplishing each of the phases. Corrective action is not limited to procurement or manufacturing operations, but includes the areas of design, construction and operation. The results of each phase shall be documented and become part of corrective action records. Quality Assurance shall review corrective action records to determine adequacy as soon as effectiveness can be measured. Effectiveness shall be continuously monitored as a function of quality surveillance. The corrective action shall not be completed until results of the corrective action have been evaluated and approved by Quality Assurance.

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When material supplied by a vendor or subcontractor has been rejected, Quality Assurance shall promptly notify the supplier in writing of the reason for rejection and request corrective action. The supplier shall be required to provide the following information:

- (a) Description of all factors contributing to the deficiency.
- (b) Description of corrective actions taken to prevent recurrence of the discrepancy in future production.
- (c) Identification of effectivity point in production.

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17.0 QUALITY ASSURANCE RECORDS

17.1 Maintenance and Access to Records

The records system maintained by Chem-Nuclear Systems, Inc. includes the retention of those fabrication, inspection and surveillance records essential to demonstration of product quality. It provides for the identification of materials and correlation of manufacturing, installation, test and inspection records and certificates. Operating records maintained will include inspection, test and audit results. Maintenance of the record file system is the responsibility of Quality Assurance. All records pertaining to a specific project shall be made available for review by the appropriate inspection agencies, the customer and/or his representative. A list of required records and their storage locations will be maintained by Quality Assurance. All records will be maintained according to established procedures, and will be identifiable and retrievable.

17.2 Contents of Record Files

It is the policy of Quality Assurance to provide and maintain adequate records of all component and material inspections and tests, supplier and subcontractor quality assurance implementation audits and reviews, and Chem-Nuclear Systems, Inc. internal quality assurance implementation audits and reviews. Records shall be kept for control and as evidence of inspections, tests, audits, monitoring of work performance, material analysis and certifications, i.e., record files shall contain all documents pertaining to product quality assurance functions. The files shall also contain procedures and specifications written for a specific project. All reports shall reference the procedure and revision used, the results, the date, the identification of the inspector or person performing the test, the equipment used and the item examined. Files of personnel qualifications shall also be maintained.

17.3 Permanent Records

Permanent records in the record file shall contain: design specifications, stress reports or stress calculations, "as built" and interface control drawings, copies of all certified material test reports,

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tabulation of materials for "as built" configuration, nondestructive examination reports, including examination results and disposition reports.

17.4 Non-permanent Records

All non-permanent records required to verify compliance with the applicable codes and the supplier's or subcontractor's Quality Assurance Program shall be maintained until project completion, unless otherwise stipulated.

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## 18.0 AUDITS

Audits to be performed will be dependent on the safety significance of the activity being audited. To verify the effectiveness of the Quality Assurance Program, CNSI applies a system of planned and scheduled audits. Audits include evaluation of quality system practices and/or procedures and the effectiveness of their implementation, monitoring of operations and activities, a review of pertinent documents and their control and maintenance. Audit procedures shall be established prior to conducting an audit.

### 18.1 Audit Schedule

Audits shall normally be conducted once every 12 months, however, unscheduled audits may be performed more frequently in specific areas, if deemed necessary by Quality Assurance and/or when the need is indicated by the existence of chronic problems. All audits shall be performed on a random, unannounced basis to assure optimum effectiveness and a prompt disclosure of deficiencies.

### 18.2 Audit Personnel

Audits shall be performed by CNSI personnel with no direct line responsibility for the function audited. The audit personnel shall have the required level of technical capability to accomplish the audit functions satisfactorily. When required, representatives from various CNSI departments may be called upon for technical advice or assistance.

### 18.3 Audit Reports

An oral presentation of the findings and conclusions of the audit is made to the Department Manager, Quality Assurance Manager, and other personnel affected by the audit findings. The items recommended for improvement in the quality assurance program are presented as well as recommendations of approaches for accomplishing these improvements.

Following the audit, a written report containing the findings and recommendations reviewed in the oral report is prepared and distributed to the responsible division personnel and the appropriate Headquarters personnel.

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Audits shall include an assessment as to how well the Quality Assurance Program meets regulatory or other requirements.

18.4 Audit Follow-Up

The originator of an audit report or a designated alternate is required to follow an open item until action is taken to satisfy an audit action item. Records of actions taken to achieve resolution are maintained. Follow-up actions are taken to verify corrective action is effective.

Responsible management personnel shall evaluate each audit report item and correct deficiencies as promptly as possible after they are revealed.

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APPENDIX D

CRIMP-A-CAP Installation, Operation and Maintenance Manual.

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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

CNSI SAFETY REVIEW  
 BOARD APPROVAL  
 BY [Signature]  
 DATE 11/31/79

REVISION STATUS

SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
REV.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SHEET	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
REV.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PREPARED <u>G. Brady</u>	DATE <u>1/12/79</u>	<b>CHEM – NUCLEAR SYSTEMS, INC.</b>  CRIMP-A-CAP INSTALLATION, OPERATION AND MAINTENANCE MANUAL  <span style="float: right; font-size: 1.5em;">701 107</span>					
CHECKED <u>JES</u>	DATE <u>1/12/79</u>						
ENGINEER <u>JR. Potter</u>	DATE <u>1/12/79</u>						
QUALITY <u>B. Scinis</u>	DATE <u>1/12/79</u>						
APPROVED <u>[Signature]</u>	DATE <u>1/12/79</u>	CONTRACT NO.	DOCUMENT NO. EN-OP-001	REV. -	SHEET 1		

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## 1.0 SCOPE

### 1.1 Purpose

This document outlines installation, operation and maintenance procedures for the Chem-Nuclear Systems, Inc. (CNSI) CRIMP-A-CAP 55-gallon drum lid crimper. Procedures for both the Standard Electric/Hydraulic and Optional Pneumatic/Hydraulic power supply units are included.

### 1.2 Applicability

This procedure applies to CNSI CRIMP-A-CAP 55- gallon drum lid crimper.

## 2.0 REFERENCES

Not applicable.

## 3.0 CRIMP-A-CAP SYSTEM DESCRIPTION

The Chem-Nuclear Systems (CNSI) CRIMP-A-CAP is a remotely-operated drum lid crimping system (Figure 1). The CRIMP-A-CAP provides a leak tight seal for containers with a top opening that conforms to DOT 17H 55-gallon drum opening or with similar openings and reinforcements. The CRIMP-A-CAP's maximum lifting and holding capacity is 1,000 pounds.

The CRIMP-A-CAP system consists of:

- (a) Capping/Crimping Head
- (b) Crimping Lid
- (c) Power Supply
- (d) Interconnecting Hoses

The standard CRIMP-A-CAP employs an electric-powered hydraulic pump to operate the crimping head. An optional pneumatic-powered hydraulic pump is also available. Optional proximity switches are available which permit remote indication of lid engagement for semi or fully automated crimping applications.

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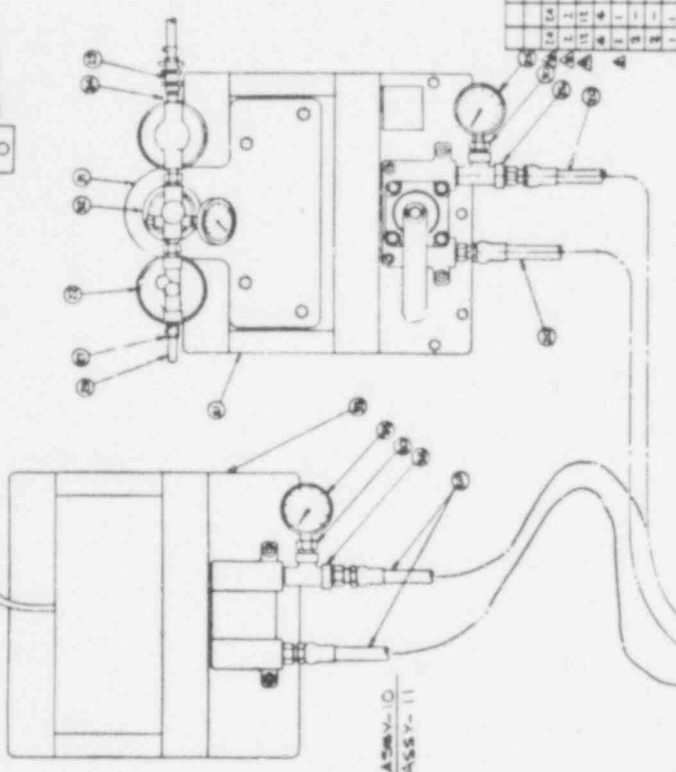
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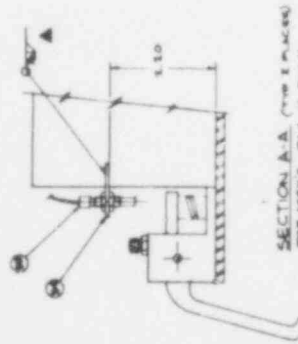
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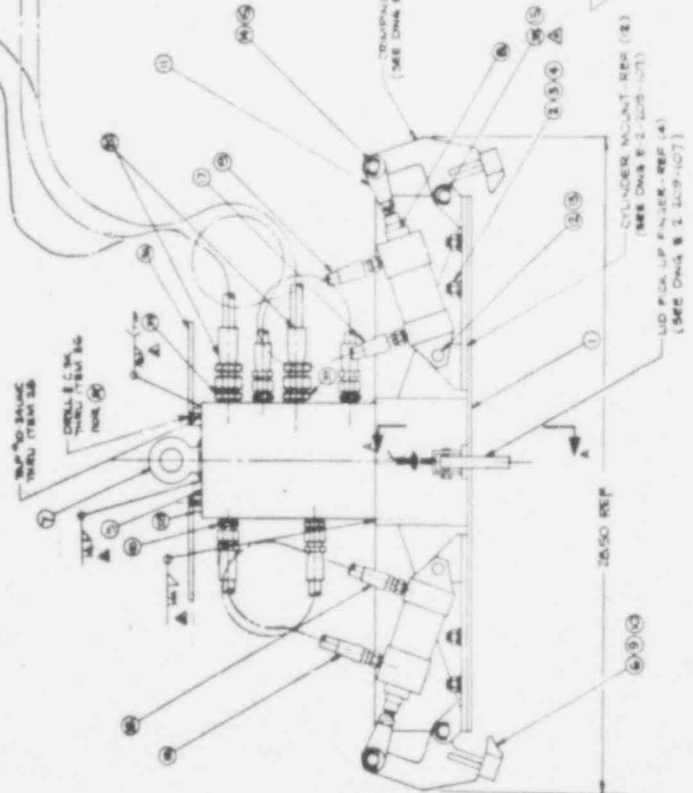
PREMIANT CONTROL



ASSY-10  
ASSY-11



SECTION A.A. (TYPE B PLACES)  
FOR ASSY-10-01-11 ONLY



PART NO. DESCRIPTION

2-209-110-00	AS HVD W/3 PRESS SWITCH
2-209-110-01	AS HVD W/3 PRESS SWITCH
2-209-110-10	BLU/RED AND PINK SWITCH
2-209-110-11	BLU/RED AND PINK SWITCH

NOTE: ALL BLENDED SEPARATES WITH ONE  
ONE "P" PART NO. "A" ONLY

1. OBTAIN ALL BLENDED AND SHARP DIMENSIONS  
2. DIMENSIONS SHALL BE GIVEN BY DIMENSIONS  
3. DIMENSIONS SHALL BE GIVEN BY DIMENSIONS  
4. DIMENSIONS SHALL BE GIVEN BY DIMENSIONS  
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10. DIMENSIONS SHALL BE GIVEN BY DIMENSIONS

1	ADAPTOR	Ø DIA 57-110	2-209-110-00
2	ADAPTOR	Ø DIA 57-110	2-209-110-01
3	CLEVIS PIN		2-209-107-12
4	FLAT HD SCREW	W/2 SEALING W/3	Ø DIA 10
5	RING	12.000 X 8.10 X 3.0 THK	Ø DIA 10
6	PROXIMITY SWITCH	Ø DIA 10	2-209-107-10
7	BRACKET		2-209-107-11
8	BRACKET		2-209-107-12
9	BRACKET		2-209-107-13
10	BRACKET		2-209-107-14
11	BRACKET		2-209-107-15
12	BRACKET		2-209-107-16
13	BRACKET		2-209-107-17
14	BRACKET		2-209-107-18
15	BRACKET		2-209-107-19
16	BRACKET		2-209-107-20
17	BRACKET		2-209-107-21
18	BRACKET		2-209-107-22
19	BRACKET		2-209-107-23
20	BRACKET		2-209-107-24

DESIGN SYSTEMS, INC.

DATE	2-2-53
REV	1
BY	J.M.
CHECKED	J.M.
APPROVED	J.M.
PROJECT	2-209-110
DRAWING NO.	2-209-110-01
TITLE	HEAD ASSEMBLY
SCALE	1:1
QUANTITY	1
DATE	2-2-53
BY	J.M.
CHECKED	J.M.
APPROVED	J.M.

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General technical specifications for the CRIMP-A-CAP are:

(a) Weight: Capping Head: 245 lbs.

Electric/Hydraulic ENERPAC: 60 lbs.

30-ft. Hydraulic Hose Assembly: 10 lbs.

Complete Unit: 315 lbs.

(b) Dimensions:

Outside dia. of head crimp jaws open  $28\frac{1}{2}$  in.

Outside dia. of head crimp jaws closed  $29\frac{1}{2}$  in.

Height of crimp head 16 in. overall

Distance of crimp head to center of lifting eye 15 in.

Inside dia. of jaws open  $24\frac{1}{2}$  in.

Inside dia. of jaws closed  $22\frac{1}{2}$  in.

(c) Power Requirement:

Standard CRIMP-A-CAP

Power Supply: ENERPAC "HUSH PUP" Model PEM/PER 1541  
Electric/Hydraulic Pump

Power Requirements: 110 VAC 20 AMP Service

Power Supply Cord: 6 ft grounded

Remote Operating Pendant: 5 ft

Optional Power Supply

ENERPAC Model #PAM 11/1 Pneumatic/Hydraulic Pump

Power Requirement: 3 CFM at 100 PSI

(d) Capping Lids:

Capping lid weight is 6 lbs.

Capping lid dia. is 24 in.

Capping lid height is  $1\frac{3}{4}$  in.

#### 4.0 REQUIREMENTS

##### 4.1 Prerequisites

Not applicable.

##### 4.2 Special Tools, Materials, Equipment

Not applicable.

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#### 4.3 Precautions

- (a) DO NOT perform a lid crimping operation in the jog position.
- (b) Use only ENERPAC HF100 oil and HF100 hydraulic fluid in ENERPAC unit.
- (c) DO NOT attempt any adjustment in capping head cylinders.
- (d) Confirm all hydraulic connections are tight prior to operating equipment.
- (e) Check lid gasket for foreign material prior to use.
- (f) DO NOT exceed the 1,000-pound maximum lift capacity of the CRIMP-A-CAP system.

#### 5.0 STANDARD ELECTRIC/HYDRAULIC CRIMP-A-CAP OPERATIONAL PROCEDURES

Each CRIMP-A-CAP is factory tested at CNSI to insure proper performance. No adjustments are required prior to installation and operation.

#### 5.1 Installation

- 5.1.1 Check reservoir oil level in Power Supply prior to operating CRIMP-A-CAP. Remove hex filler plug located on top of the reservoir next to the manual control valve lever. Oil level should be within 1/2 inch of the top. Replace hex plug. Use ENERPAC HF100 oil only.
- 5.1.2 Open air vent valve (located in hex filler plug) completely. Turn vent valve counterclockwise until it stops.
- 5.1.3 Plug in unit to a 115 VAC grounded power source. See pump name plate for pertinent electrical requirements.
- 5.1.4 Connect the hydraulic pump to the capping head by
  - (a) placing the hydraulic pump manual control valve lever to the neutral position (halfway between positions "A" and "R")
  - (b) connecting the pump outlet hose marked "R" to the UPPER capping head manifold port

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(c) connecting the pump outlet hose marked "A" to the LOWER capping head manifold port.

NOTE: "A" indicates cylinders advance position.  
"R" indicates cylinders retract position.

NOTE: Operations in 5.1.4 and 5.1.6 are not required when CNSI supplies complete unit with hoses connected.

- 5.1.5 Start the unit using the toggle switch located in the grill. Switch positions for Models PEM-1541 and PER-1541 are:  
SWITCH UP for continuous operation  
SWITCH DOWN for jogging operation.  
SWITCH CENTER for neutral.  
Model PER-1541 also features a remote control pendant station.

NOTE: DO NOT CRIMP IN JOG POSITION.

- 5.1.6 Tilt the unit and jog the motor (switch down) several times. Allow motor to idle to a complete stop between "jogs". Return switch to off (center) position.

Switch to the "run" position (switch up) and allow unit to warm-up for about five (5) minutes. The foregoing steps are essential to prime the high pressure pistons.

- 5.1.7 Work the air out of the system by advancing and retracting capping head cylinders (by moving the hydraulic pump manual control lever to "A" or "R"). Erractic motion of cylinder rods means air is in the system. If air continues to be a problem, elevate the pump above the cylinders until there is a smooth motion of the cylinder rods.

- 5.1.8 Recheck reservoir oil level in the power supply. Add oil if needed.

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NOTE: DO NOT attempt any adjustments in the capping head cylinders. They have been adjusted for optimum operation and performance. If damage or excessive wear occurs and crimping is no longer satisfactory, contact CNSI.

## 5.2 Operation

- 5.2.1 Turn air vent valve out completely (counterclockwise).
- 5.2.2 Position the control valve lever in "neutral" position (center).
- 5.2.3 Confirm that all hydraulic connections are tight.
- 5.2.4 Connect power cord to a 110 - 120 VAC grounded outlet.
- 5.2.5 Switch to "run" position and idle for a few minutes.
- 5.2.6 Advance and retract cylinders a few times to remove air (see Section 2.1.7). Smooth motion of the cylinder rods indicates no air in the system.
- 5.2.7 Remove capping head from its storage position and place over a lid. Lower the capping head until its fingers snap beneath the lip of the lid to be picked up. Confirm all four fingers are engaged.

NOTE: Check lid gasket area for foreign material. Clean if necessary.

- 5.2.8 Position capping head with lid over drum to be capped.
- 5.2.9 Lower capping head on the drum until there is no tension on capping head carrying cable.
- 5.2.10 Crimp lid by moving pump manual control valve lever to position "A" (advance). Continue crimping operation until the hydraulic pressure on the ENERPAC unit reaches approximately

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(c) connecting the pump outlet hose marked "A" to the LOWER capping head manifold port.

NOTE: "A" indicates cylinders advance position.  
"R" indicates cylinders retract position.

NOTE: Operations in 5.1.4 and 5.1.6 are not required when CNSI supplies complete unit with hoses connected.

- 5.1.5 Start the unit using the toggle switch located in the grill. Switch positions for Models PEM-1541 and PER-1541 are:  
SWITCH UP for continuous operation  
SWITCH DOWN for jogging operation.  
SWITCH CENTER for neutral.  
Model PER-1541 also features a remote control pendant station.

NOTE: DO NOT CRIMP IN JOG POSITION.

- 5.1.6 Tilt the unit and jog the motor (switch down) several times. Allow motor to idle to a complete stop between "jogs". Return switch to off (center) position.

Switch to the "run" position (switch up) and allow unit to warm-up for about five (5) minutes. The foregoing steps are essential to prime the high pressure pistons.

- 5.1.7 Work the air out of the system by advancing and retracting capping head cylinders (by moving the hydraulic pump manual control lever to "A" or "R"). Erratic motion of cylinder rods means air is in the system. If air continues to be a problem, elevate the pump above the cylinders until there is a smooth motion of the cylinder rods.

- 5.1.8 Recheck reservoir oil level in the power supply. Add oil if needed.

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NOTE: DO NOT attempt any adjustments in the capping head cylinders. They have been adjusted for optimum operation and performance. If damage or excessive wear occurs and crimping is no longer satisfactory, contact CNSI.

## 5.2 Operation

- 5.2.1 Turn air vent valve out completely (counterclockwise).
- 5.2.2 Position the control valve lever in "neutral" position (center).
- 5.2.3 Confirm that all hydraulic connections are tight.
- 5.2.4 Connect power cord to a 110 - 120 VAC grounded outlet.
- 5.2.5 Switch to "run" position and idle for a few minutes.
- 5.2.6 Advance and retract cylinders a few times to remove air (see Section 2.1.7). Smooth motion of the cylinder rods indicates no air in the system.
- 5.2.7 Remove capping head from its storage position and place over a lid. Lower the capping head until its fingers snap beneath the lip of the lid to be picked up. Confirm all four fingers are engaged.

NOTE: Check lid gasket area for foreign material. Clean if necessary.

- 5.2.8 Position capping head with lid over drum to be capped.
- 5.2.9 Lower capping head on the drum until there is no tension on capping head carrying cable.
- 5.2.10 Crimp lid by moving pump manual control valve lever to position "A" (advance). Continue crimping operation until the hydraulic pressure on the ENERPAC unit reaches approximately

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3,500 PSI and there is no further pressure increase with continued operation of the air pump.

NOTE: Maximum lift capacity of the CRIMP-A-CAP unit is 1,000 pounds at 3,500 PSI.

- 5.2.11 Retract crimping jaws by moving pump manual control valve lever to position "R" (retract). Operate the hydraulic pump until all crimping jaws are retracted.
- 5.2.12 Release hydraulic pressure by moving manual control valve lever to neutral (center).
- 5.2.13 Lift and move the capping head off the capped drum. Make certain that lifting is vertical and lid pick-up fingers clear the crimped lid.

### 5.3 Maintenance

- 5.3.1 Check oil level every 40 hours of operation or more often if external leakage is noted in the hydraulic system. Oil level with all cylinders retracted should be about 1/2 inch from the top of the reservoir. If additional oil is required, add only ENERPAC HF100 hydraulic fluid.

NOTE: Clean the area around the filler plug before adding oil. Remove filler plug and add oil using a clean funnel with a filter.

- Completely change oil every 300 hours of operation. In an extremely dirty environment, oil must be changed more frequently.

- 5.3.3 To change oil:
  - (a) Remove the shroud.
  - (b) Remove the hex head capscrews holding the pump unit to the reservoir.

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- (c) Lift pump unit and cover off the reservoir. Be careful not to damage the gasket.
- (d) Remove screens and clean with kerosene or similar cleaning agent.
- (e) Remove the two magnets and clean them.
- (f) Dump the oil and clean the reservoir.
- (g) Reinstall screen and magnets.
- (h) Lift the pump unit on the reservoir - make sure gasket is in place.
- (i) Tighten all screws and reinstall shroud.
- (j) Fill the reservoir to 1/2 inch from top with ENERPAC HF100 oil.
- (k) Repeat all steps listed in Section 5.1.

## 6.0 OPTIONAL PNEUMATIC/HYDRAULIC CRIMP-A-CAP OPERATIONAL PROCEDURES

Except as noted below, the installation, operation and maintenance procedures for the ENERPAC Pneumatic/Hydraulic power supply Model PAM-1100 are the same as those for the ENERPAC Electric/Hydraulic power supply Model PEM-1541 (see Section 5.0).

### 6.1 Installation

- 6.1.1 Connect plant air supply to the Schrader 3533-1000 air filter on the power supply unit. Adjust the air pressure regulator to  $95 \pm 5$  PSI.

NOTE: This unit does not require a 115 VAC grounded power source (Section 5.1.3).

### 6.2 Operation

- 6.2.1 This unit requires no 110 - 120 VAC power connection (Section 5.2.4). For satisfactory operation of the pneumatic/hydraulic power supply, a minimum plant air supply of 3.0 CFM at 100 PSI (or equivalent) is required.

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## 6.3 Maintenance

6.3.1 Regularly clean the Schrader 3533-1000 air filter.

6.3.2 Maintain oil level in the Schrader 3583-1000 lubricator using 10-weight motor oil. Clean regularly.

## 7.0 RECOMMENDED SPARE PARTS AND ORDERING INFORMATION

### 7.1 CRIMP-A-CAP

#### 7.1.1 Spare Parts

<u>Quantity</u>	<u>Item</u>	<u>Reference Designation</u>
1 ea.	Cylinder	2-209-110-8
2 ea.	Clevis	2-209-110-11
1 ea.	Shoe	2-209-103
2 ea.	Clevis Pin	2-209-110-14
2 ea.	Clevis Pin	2-209-110-38
4 ea.	Socket Head Capscrew	1/4-20 x 3/4
4 ea.	Lockwasher	1/4-in. dia.
6 ea.	Retaining Ring, E-Type	1/2-in. dia. x 0.043 in.
1 ea.	Hose, 1/4-in. dia. x 12-1/2 in.	2-209-110-16
1 ea.	Hose, 1/4-in. dia. x 16-3/4 in.	2-209-110-17
1 ea.	Hose, 1/4-in. dia. x 17-3/4 in.	2-209-110-18
1 ea.	Hose, 1/4-in. dia. x 19-3/4 in.	2-209-110-19
1 ea.	Lid Finger	2-209-107-11
2 ea.	Spring	2-209-107-18
2 ea.	Clevis Pin	2-209-107-16

#### 7.1.2 Spare Parts Ordering Information:

All spare and replacement parts can be ordered from:

Purchasing Agent  
Chem-Nuclear Systems, Inc.  
P.O. Box 1866  
Bellevue, WA. 98009  
(206-827-0711)

All requests must be accompanied by the model and serial numbers of the CRIMP-A-CAP requiring servicing.

701 119

DOCUMENT

EN-OP-001

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HEET

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7.2 Electric/Hydraulic Power Supply

7.2.1 Spare Parts

<u>Quantity</u>	<u>Item</u>
1	Repair Kit PEM 1500K

7.2.2 Spare Parts Ordering Information

All spare parts information can be obtained from:

ENERPAC  
Butler, Wisconsin 53004  
(414-871-6600)

7.3 Pneumatic/Hydraulic Power Supply

7.3.1 Spare Parts

<u>Quantity</u>	<u>Item</u>
1	Repair Kit PAM 1100K

7.3.2 Spare Parts Ordering Information

All spare parts information can be obtained from:

ENERPAC  
Butler, Wisconsin 53007  
(414-781-6600)

701 120

DOCUMENT

EN-OP-001

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APPENDIX A

CRIMP-A-CAP  
PERFORMANCE TESTS

## CRIMP-A-CAP PERFORMANCE TESTS

### 1.0 CAPPING LID SEALANT THERMAL QUALIFICATION TEST (COLD TEST -40°F)

#### 1.1 Purpose

This test was performed to determine if the butyl rubber elastomer base sealant exhibits substantially reduced effectiveness at an ambient temperature of -40°F in still air and shade.

#### 1.2 Results

The sealant exhibited 2½ times as much elasticity at room temperature as at -50°F. A greater force was required to separate the sealant from the coupon at -40°F than at normal room temperatures. The material is easily subjected to flexure without embrittlement or fracture.

### 2.0 D.O.T. FOUR-FOOT DROP TEST WITH A FILLED 55-GALLON DRUM

#### 2.1 Purpose

This test was performed to determine if a capped 55-gallon drum maintains its integrity after being dropped four feet onto a hard pavement.

#### 2.2 Results

The capped 55-gallon drum maintained its integrity after being dropped four feet onto hard pavement.

### 3.0 CRIMP-A-CAP LIFT LOAD TEST

#### 3.1 Purpose

This test was performed to determine the CRIMP-A-CAP's maximum allowable lift load capacity.

#### 3.2 Results

The CRIMP-A-CAP lifted 1,000 lbs. in a 55-gallon drum by the crimping jaws only if a 3,500 PSI crimping pressure was maintained on the hydraulic cylinders.

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4.0 CRIMP-A-CAP LEAK TEST

4.1 Purpose

This test was to determine:

- (a) if the capped drums leak under adverse conditions (i.e., when turned upside down and filled with liquid)
- (b) if the CRIMP-A-CAP can be used as a grapple for drums previously crimped and sealed.

4.2 Results

- (a) The capped drums did not leak while inverted for eight hours.
- (b) The CRIMP-A-CAP picked up and held a previously filled and sealed drum for ten minutes.

701 123

DOCUMENT

EN-OP-001

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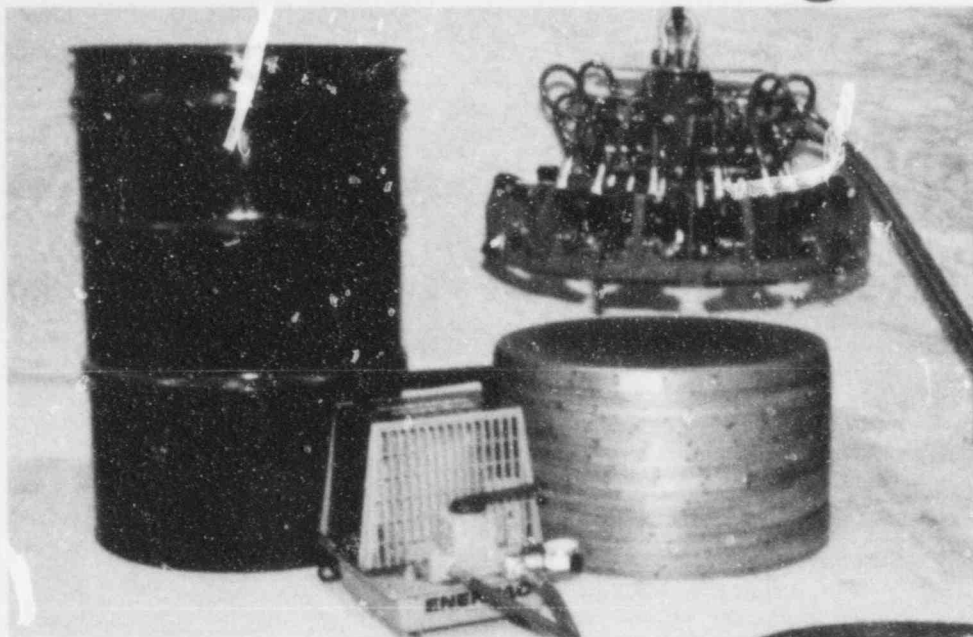
15

APPENDIX B

CNSI CRIMP-A- JAP  
MARKETING INFORMATION

701 124

# Remote Lid Handling



## When it comes to solving container capping exposure problems—go with Crimp-a-Cap!

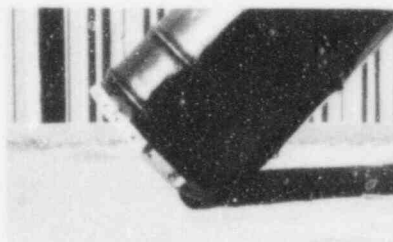
Designed for manual lid-loading, or self-loading a single lid from a magazine for remote capping, CNSI's Crimp-a-Cap can accomplish its task on any size container with the equivalent of a DOT-17H 55-gallon drum opening. You have positive closure of vertical containers every time. Anyone can perform even the remote operation with minutes of training. The CNSI capping unit's weight and simple lid design facilitates easy alignment and task accomplishment any place accessible by light weight crane.

## Sealed, Safe, Secure after 4-Foot Drop!



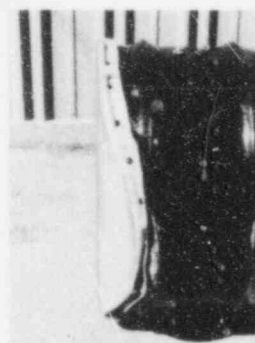
Freefall

Photo showing test drop on hard pavement. Drum shown is filled to capacity.



Impacting

Impact! Photo taken at exact time drum hit ground from a height of four feet.



Sealed, Safe, Secure  
Although Cap Bent!

The drum shown here at rest after test drop and integrity maintained.

Simplicity, remote operability, flexibility and integrity; plus a lid closure technique that meets the DOT four-foot drop standard. Tests have proved Crimp-a-Cap closure of 55-gallon drums is equal to the bolted ring lid.



**CHEM NUCLEAR SYSTEMS, INC.**

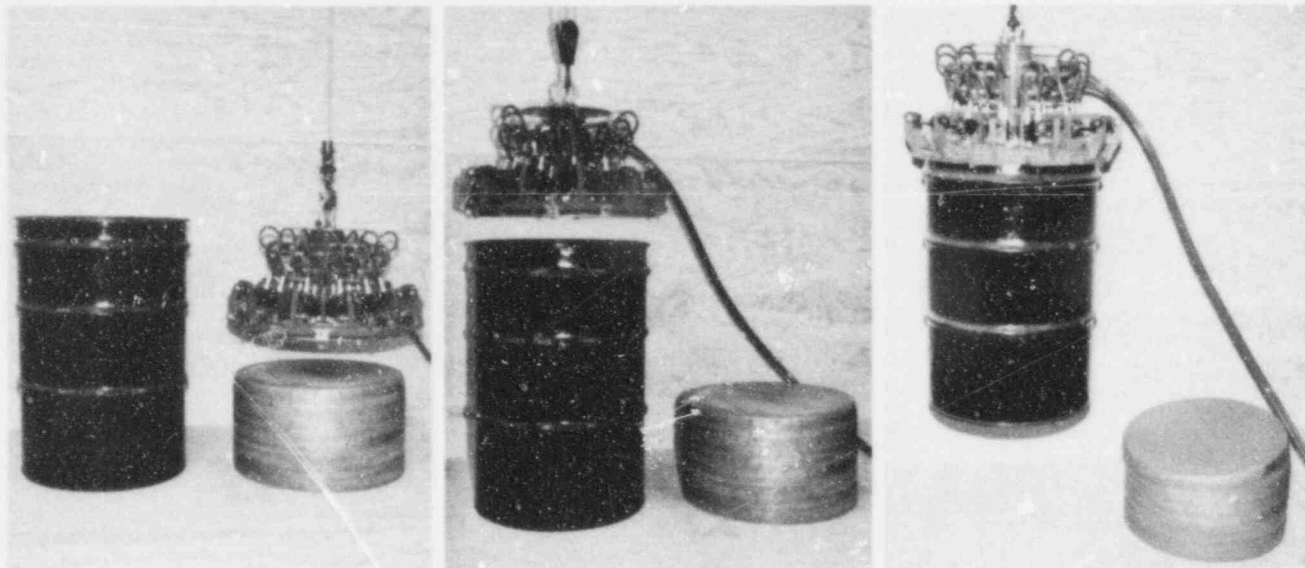
P.O. Box 1866 / Bellevue, Wa.

Phone: (206) 827-0711

701 125

**POOR ORIGINAL**

# The Capping Achievement



## Delivered by Crimp-a-Cap™

Filled radioactive waste containers present problems. Mainly, how to cap them remotely, simply and positively after they're filled.

Realizing this, Chem-Nuclear has developed and tested a uniquely-designed unit which provides the same closure integrity as the bolted ring 55-gallon drum lid. Only better. CNSI's Crimp-a-Cap unit and lid features easy, positive lid locating characteristics allowing excellent remote operability and problem-free repeated closures.

In addition, since no downward force is required, the Crimp-a-Cap operates at the end of a cable. It can perform remote capping operations anywhere, plus pick up and move filled and capped 55-gallon drums weighing up to 1,000 pounds.

Crimp-a-Cap unit operation requires only plant air (80-100 PSIG) or electric power (115 or 230 VAC, 60 cycle) and a light duty crane to move the unit on and off the cappable container.

## CHEM-NUCLEAR SYSTEMS, INC. POOR ORIGINAL

*"The Leader in Nuclear Waste Management and Support Services"*

### Corporate and Western Operations

P. O. Box 1866  
Bellevue, WA 98009  
(206) 827-0711

### Southeast/Southwest Operations

P. O. Box 726  
Barnwell, SC 29812  
(803) 259-1781



### Northeast/Midwest Operations

3625 Eggert Road  
Orchard Park, NY 14127  
(716) 662-2562

### Compliance Assistance and Technical Services

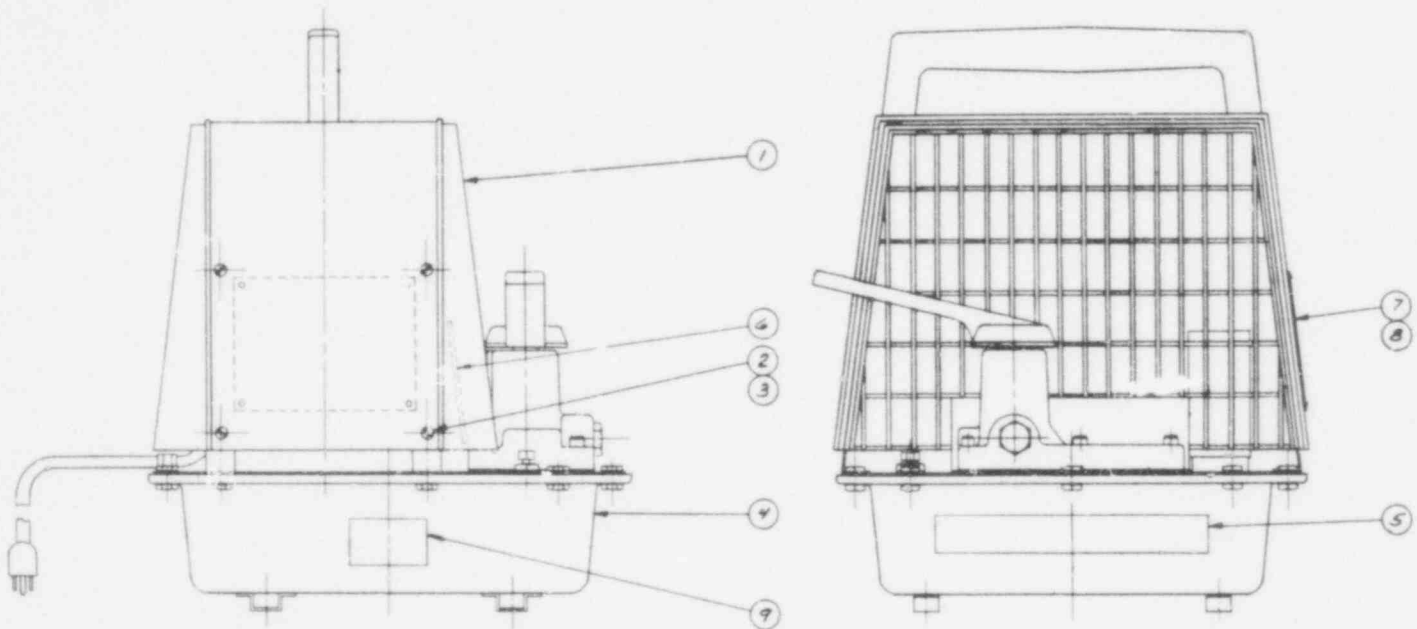
6135 Barfield Road, Suite 110  
Atlanta, GA 30328  
(404) 393-4507

We are an Equal Opportunity Employer.

APPENDIX C

ENERPAC ELECTRIC/HYDRAULIC  
POWER SUPPLY DATA SHEETS

701 127

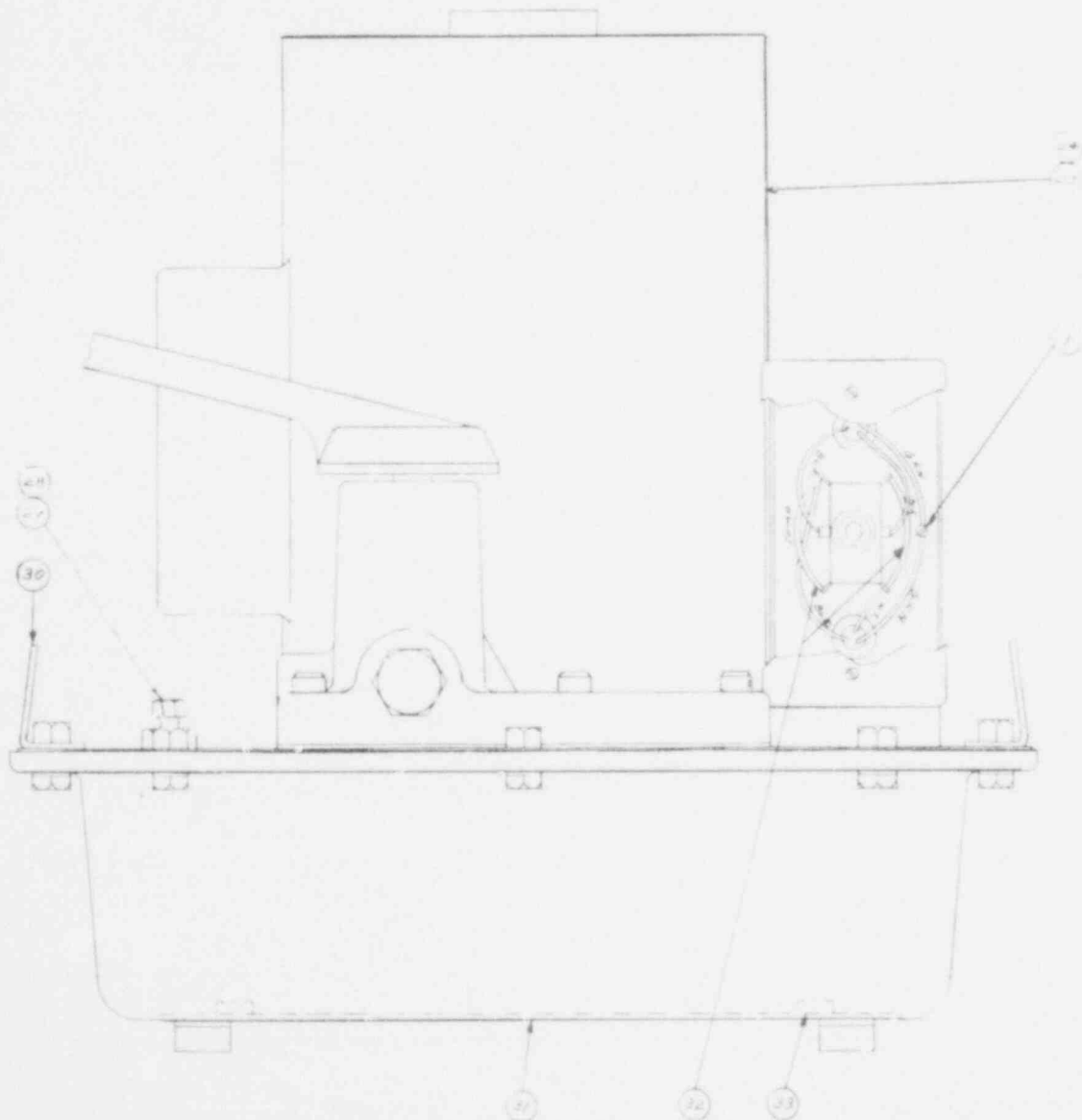
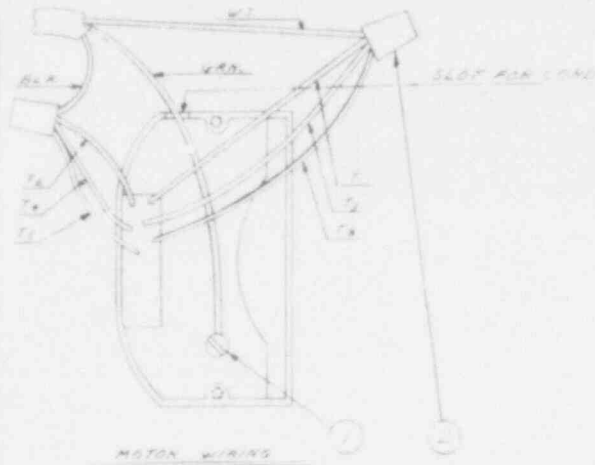
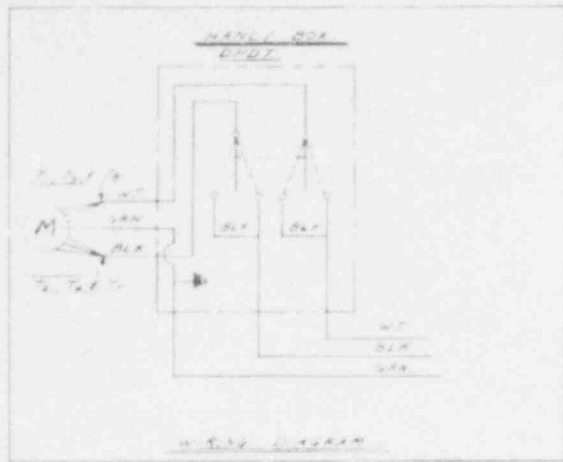


### PARTS LIST

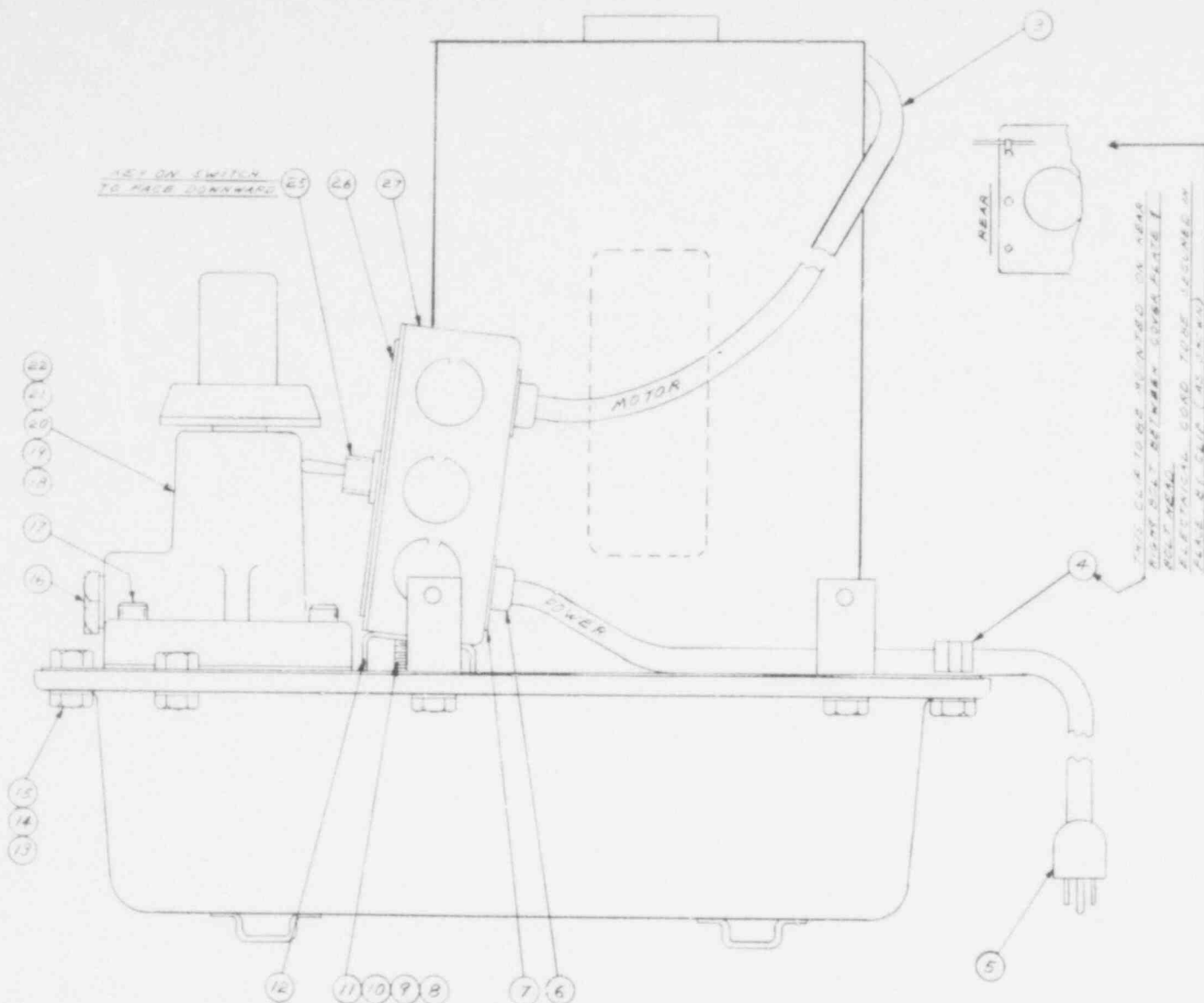
Item No.	Part Number	No. Req.	Description
1	Y555.950	1	Grill & Cover Sub-Ass'y.
2	F866.028	4	Machine Screw
3	M783.055	4	Speed Nut
4		1	Pump
5	G425.026	2	Decal (Enerpac)
6	Y565.026	1	Name Plate (Run-Jog)
7	Y685.026	1	Name Plate
8	Y697.003	4	Pop Rivet
9	Z-435	1	Transfer (Patent)

701 128

TO PROTECT YOUR WARRANTY, USE ONLY ENERPAC HYDRAULIC OIL.



**POOR ORIGINAL**



PARTS LIST

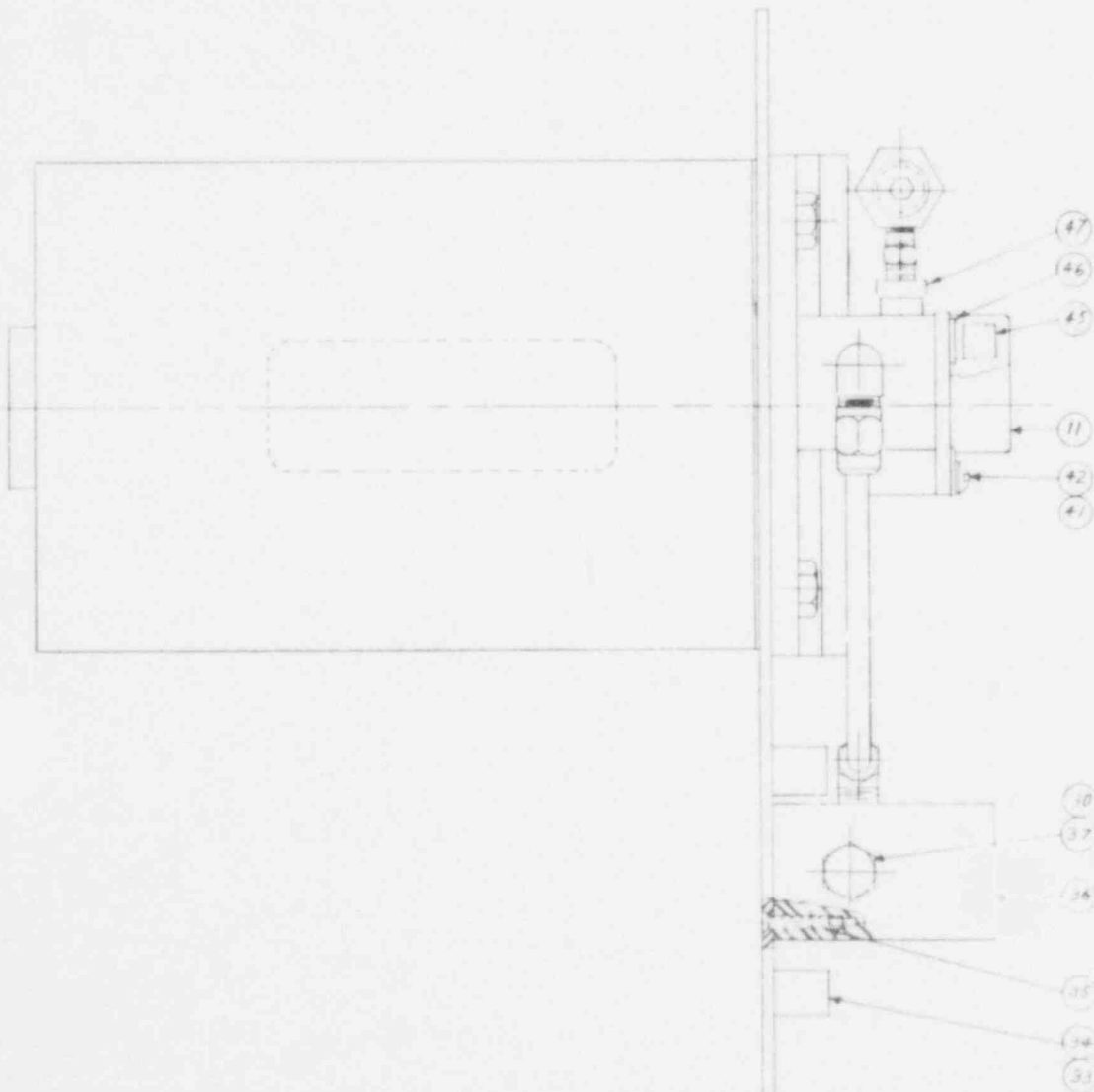
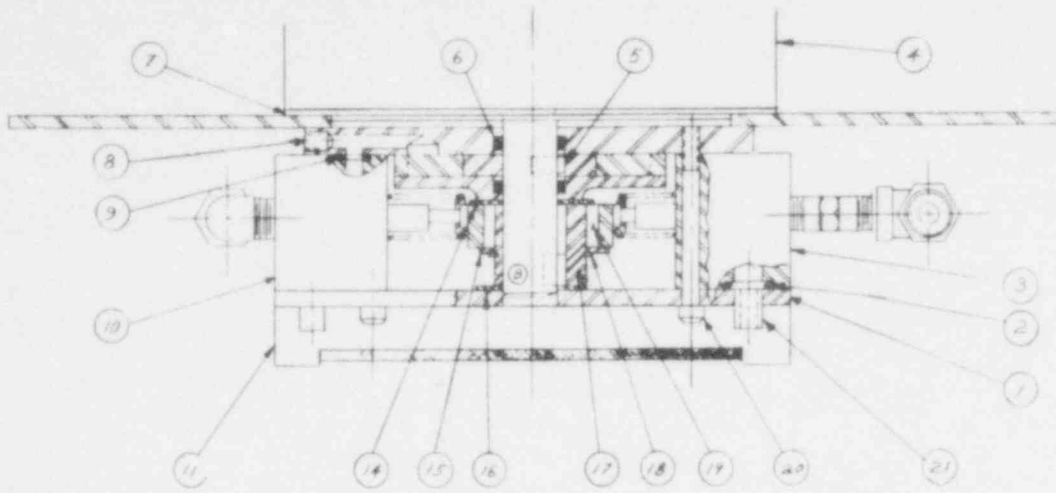
PARTS LIST

Item No.	Part Number	No. Req.	Description	Item No.	Part Number	No. Req.	Description
1	C302.128	2	Screw	19	C162.096	1	Connector
2	G536.055	2	Connector	20		2	"O" Ring
3	Y549.900	1	Electrical Cord	21		2	Back-Up
4	Y99.017	1	Clip	22		1	Gasket
5	Y550.900	1	3-Conductor Cord	23	CA156.900	1	Pump & Cover Ass'y.
6	M850.007	2	Bushing	24		1	Gasket
7	Y547.038	2	Adaptor	25	Y581.372	1	Taggle Switch
8	B1330.028	2	Hex. Sac. Hd. Cap Screw	26	Y560.098	1	Handy Box Cover
9	AJ100.299	2	Lock Washer	27	Y558.980	1	Handy Box
10	Y758.108	2	Washer	28	C514.900	1	Air Vent Valve
11	A8016.021	2	Nut	29		1	Gasket
12	Y646.111	1	Bracket	30	M780.111	4	Bracket
13	B1003.046	12	Hex. Hd. Cap Screw	31	Y516.025	1	Reservoir
14	B1015.066	12	Lock Washer	32	Y664.900	2	Jump Wire
15	B1001.123	12	Hex. Nut	33	C187.018	2	Magnets
16	R515.245	1	Pipe Plug	34	EATS 116	1	Ass'y & Test Spec.'s
17	B1349.028	6	Hex. Sac. Hd. Cap Screw	35	L919.885	42	Hydraulic Oil
18	C792.900	1	2-Way Valve				

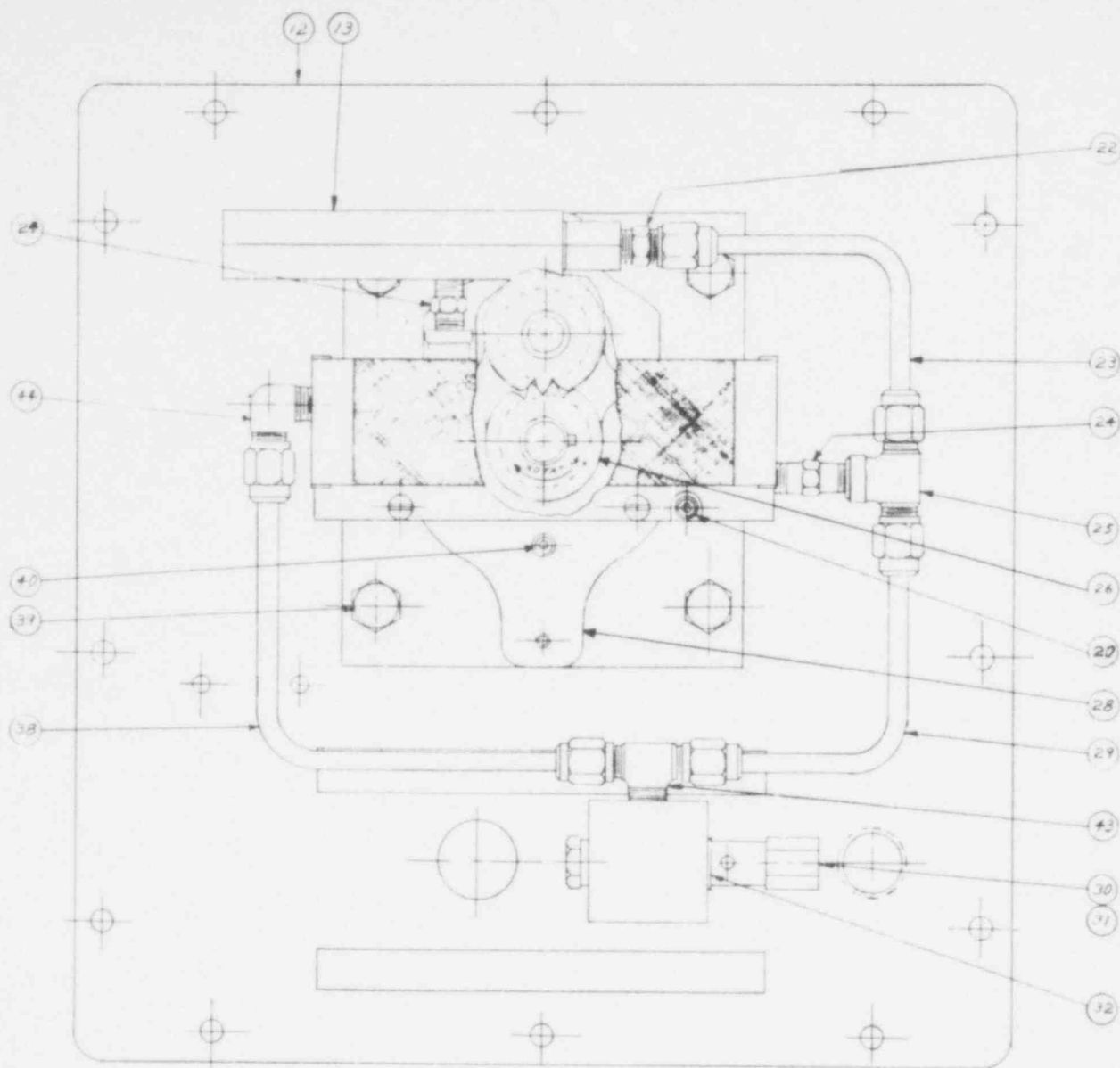
Items 20, 21, 22, 24 And 29 Are Included In Repair Kit PEM-1500K

701 130





701 131

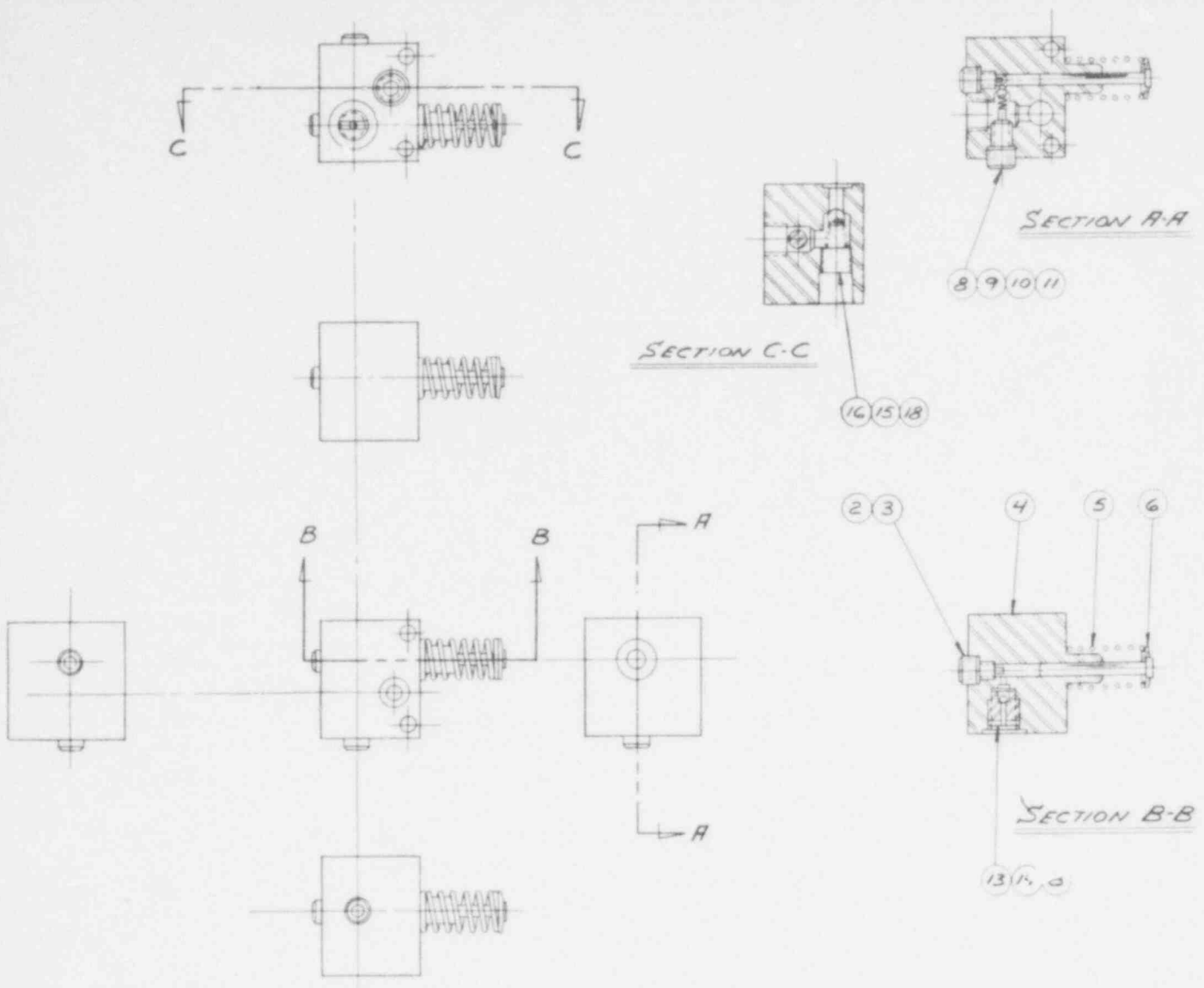


PARTS LIST

PARTS LIST

Item No.	Part Number	No. Req.	Description	Item No.	Part Number	No. Req.	Description
1	Y533.101	1	Plate	24	C642.395	2	Nipple
2		2	"O" Ring	25	Y709.096	1	Tee
3	CF67.900	1	Piston & Block Ass'y.	26	Y734.900	1	Gear & Bearing Ass'y.
4	Y233.259	1	Motor	28	Y456.101	1	End Plate
5	Y710.061	1	Pin	29	Y648.268	1	Tube Ass'y.
6		2	Oil Seal	30	B159.167	2	Gasket
7		1	Gasket	31	P181.190-2	1	Relief Valve
8	R385.300	1	Set Screw	32	A1009.245	1	Flush Plug
9		1	"O" Ring	33	L837.101	2	Bolting Block
10	CF66.900	1	Piston & Block Ass'y.	34	M922.028	4	Ft. Hd. Soc. Cap Screw
11	Y810.018	1	Screen	35	Y971.028	4	Ft. Hd. Soc. Cap Screw
12	Y596.900	1	Gear Housing & Cover Assembly	36	Y927.038	1	Adaptor Block
13	Y591.900	1	Unloading Valve Ass'y.	37	AJ100.061	1	Hex. Head Valve Plug
14	Y521.108	1	Thrust Washer	38	Y524.268	1	Tube Assembly
15	Y552.108	1	Thrust Washer	39	B1077.046	4	Hex. Hd. Cap Screws
16	M886.108	1	Thrust Washer	40	B1324.028	6	Hex. Soc. Hd. Cap Screw
17	Y520.350	1	Eccentric	41	SJ100.169	2	Washer
18	A8063.049	1	Ret. Ring	42	M474.028	2	Self Tapping Screw
19	Y735.900	1	Race & Bearing Ass'y.	43	Y530.096	1	Tee
20	B1338.028	4	Hex. Soc. Hd. Cap Screw	44	B202.291	1	Elbow
21	M70.268	2	Tube	45	Y716.096	1	Pipe Adaptor
22	A8013.094	1	Connector	46		1	"O" Ring
23	Y586.268	11	Tube Assembly	47	Y714.291	1	90° Elbow

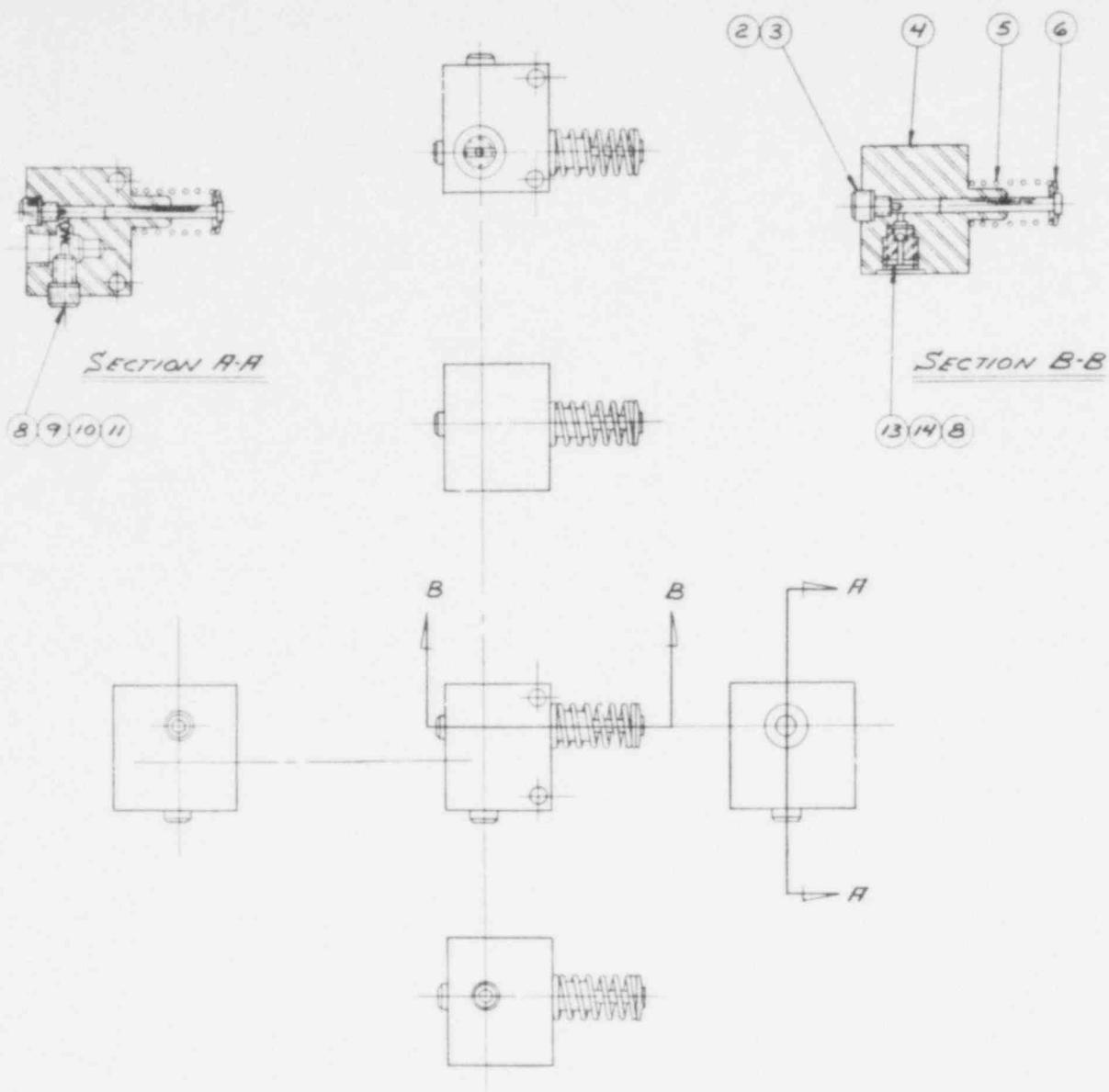
Items 2, 6, 7, 9, And 46 are Included in Repair Kit PEM-1500K.



PARTS LIST

Item No.	Part Number	No. Req.	Description
1	CF66.900	1	Pump Block Assembly
2		1	Gasket
3	P181.185	1	Plug
4	CB499.900	1	Block Sub-Assembly
5	P181.170	1	Spring
6	P181.418	1	Spring Plate
8		2	Ball
9	P181.183	1	Spring
10	S3.037	1	Gasket
11	M80.006	1	Plug
13	Y723.290	1	Intake Seat
14	P181.167	1	Gasket
15		1	Spring
16		1	Ball
18	A1007.245	1	Pipe Plug

Items 2, 8, 15, And 16 Are Included In Repair Kit PEM-1500K. 701 133



PARTS LIST

Item No.	Part Number	No. Req.	Description
1	CF67.900	1	Pump Block Assembly
2		1	Gasket
3	P181.185	1	Plug
4	CB496.900	1	Block Sub-Assembly
5	P181.170	1	Spring
6	P181.418	1	Spring Plate
8		2	Ball
9		1	Spring
10		1	Gasket
11	M80.006	1	Plug
13	Y723.290	1	Intake Seat
14	P181.167	1	Gasket

Items 2, 8, 9, And 10 Are Included In  
Repair Kits PEM-1300K And PEM-1500K.

701 134

# INSTRUCTIONS

## NORMAL PUMP OPERATION

1. Turn air vent valve out completely (counter-clockwise.)
2. Position control valve lever in "neutral" or open position.
3. Be sure all hydraulic connections are tight.
4. Connect power cord to the proper grounded outlet.
5. Switch toggle to "run" position and idle for a few minutes.
6. Advance and retract cylinder a few times to remove air.
7. To prevent oil leakage when transporting pump, close the air vent valve.

## REFILLING THE RESERVOIR & PERIODIC MAINTENANCE

1. Oil level with all cylinders retracted should be about 1/2" from the top. If additional oil is required, add only ENERPAC HF-100 hydraulic fluid.
2. Clean the area around the filler plug before adding oil. Remove filler plug and add oil, using a clean funnel with a filter.

3. Check oil level every 40 hours of operation or more often if external leakage is noted in your hydraulic system.
4. Completely change oil every 300 hours of operation. In an extremely dirty environment, oil must be changed more frequently.
5. To change oil:
  - a. Remove the shroud.
  - b. Remove the hex head cap screws holding the pump unit to the reservoir.
  - c. Lift pump unit and cover off of the reservoir. Be Careful not to damage gasket.
  - d. Remove screens and clean with kerosene or a similar cleaning agent.
  - e. Remove the two magnets and clean them.
  - f. Dump oil and clean the reservoir.
  - g. Re-install screen and magnets.
  - h. Lift pump unit on reservoir - be sure gasket is in place.
  - i. Tighten all screws and re-install shroud.
  - j. Fill reservoir to 1/2" of top with ENERPAC HF-100 oil.

## **IMPORTANT - USER SAFETY AND PROTECTION**

In setting up systems to fit your operations, care must be taken to select the proper components and design to insure appropriate integration with your operations and existing equipment and that all safety measures have been taken to avoid the risk of personal injury and property damage from your application or system.

**ENERPAC CANNOT BE RESPONSIBLE FOR DAMAGE OR INJURY CAUSED BY UNSAFE USE, MAINTENANCE OR APPLICATION OF ITS PRODUCTS.** Please contact ENERPAC for guidance when you are in doubt as to the proper safety precautions to be taken in designing and setting up your particular application.

*NOTE: Orders for parts cannot be filled unless both model and serial number with prefix imprinted on nameplate are given.*

PARTS AND SERVICE	WARRANTY	WARRANTY RETURN PROCEDURE
For quality workmanship and genuine ENERPAC parts, select a Franchised ENERPAC Service Center for your repair needs. Only repairs performed by a Franchised Service Center displaying the official ENERPAC Franchised sign are backed with full factory warranty. The Classified Section in your Phone Book lists your nearest Franchised Service Center.	ENERPAC warrants its products against defects in workmanship and materials for 90 days from date of delivery to user. Claim is not warranted. Warranty does not cover ordinary wear and tear, abuse, misuse, overloading, altered products or use of improper fluid.	When question of warranty claim arises, the user should send his unit to the nearest ENERPAC Franchised Service Center for inspection, transportation to be prepaid and evidence of purchase date furnished. If the claim comes under the terms of our warranty, the Franchised Service Center will REPAIR OR REPLACE PARTS AFFECTED and return prepaid.

# ENERPAC®

AN APPLIED POWER  INDUSTRY

701 135

ENERPAC, BUTLER, WISCONSIN 53007 DIVISION OF APPLIED POWER INC. TELEPHONE (414) 781-6600 TELEX 026-682

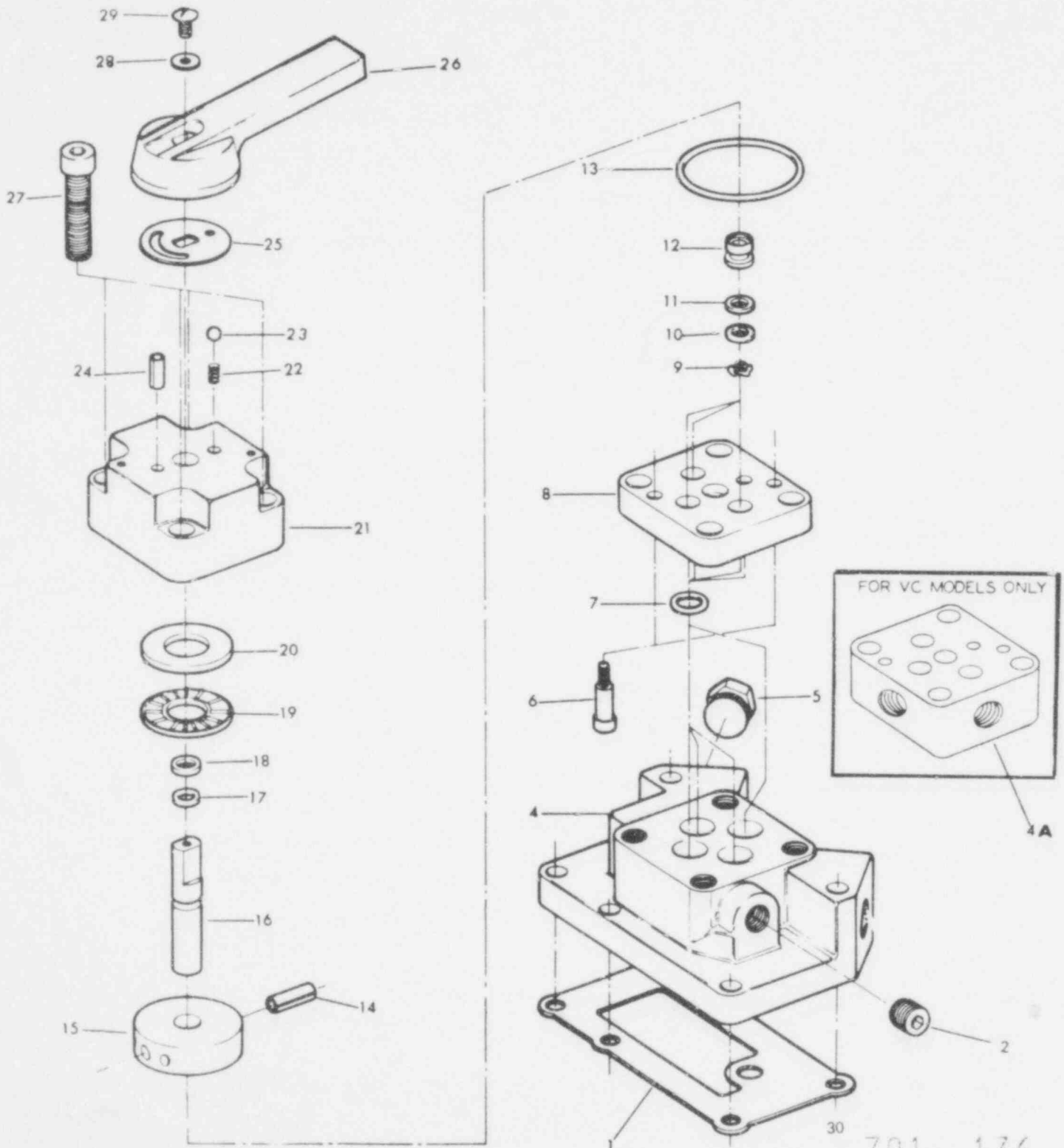
APPLIED POWER INC., MARCAS REGS.

L-640 3/76 PRINTED IN U.S.A.

# ENERPAC

## Repair Parts Sheet

4-WAY VALVES  
VC-4-1, VC-4-2,  
VC-20, VC-20-1,  
VM-4-1, VM-4-2



701 136

TO PROTECT YOUR WARRANTY, USE ONLY ENERPAC HYDRAULIC OIL.

# PARTS LIST

Item No.	DESCRIPTION	VC-4-1 & VC-20		VC-4-2 & VC-20-1		VM-4-1		VM-4-2	
		Qty.	Part No.	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.
1	Gasket	—	—	—	—	1	*	1	*
2	Plug	—	—	—	—	1	C169245	1	A1007245
4	Adaptor Block	—	—	—	—	1	C293345	1	CB303038
4A	Port Manifold	1	M176005	1	CB325005	—	—	—	—
5	Plug	4	R515245-2	4	R515245-2	2	R515245-2	2	R515245-2
6	Sec. Hd. Shd. Screw	2	M111028	2	M111028	2	M111028	2	M111028
7	"O" Ring	4	*	4	*	4	*	4	*
8	Body	1	M383190	1	CB323190	1	M383190	1	CB323190
9	Wave Spring	6	*	6	*	6	*	6	*
10	"O" Ring	3	*	3	*	3	*	3	*
11	Back-Up Ring	3	*	3	*	3	*	3	*
12	Shear Seal	3	M156041	3	CB25041	3	M156041	3	CB25041
13	"O" Ring	1	*	1	*	1	*	1	*
14	Spring Pin	1	B1148057	1	B1109057	1	B1148057	1	B1109057
15	Disc Assy. (for VM-4)	—	—	—	—	1	L302900	1	CB321071
16	(for VC-4)	1	L302900	1	CB321071	—	—	—	—
	(for VC-20)	1	Y385900	1	CB322071	—	—	—	—
16	Shaft	1	M116104	1	CB326104	1	M116104	1	CB326104
17	"O" Ring	1	*	1	*	1	*	1	*
18	Back-Up Ring	1	*	1	*	1	*	1	*
19	Needle Thrust Brg.	1	M121281	1	CB3282C1	1	M121281	1	CB328281
20	Bearing Plate	1	M164101	1	CB327101	1	M164101	1	CB327101
21	Bonnet	1	M120001	1	CB324001	1	M120001	1	CB324001
22	Spring	1	*	1	*	1	*	1	*
23	Ball	1	*	1	*	1	*	1	*
24	Spring Pin	1	B1126057	1	B1126057	1	B1126057	1	B1126057
25	Detent Disc.	1	M127071	1	A8005071	1	M127071	1	A8005071
26	Handle	1	Y325070	1	Y325070	1	Y325070	1	Y325070
27	Ferry Hd. Cap Screw	4	B2130028	4	B2130028	4	B2130028	4	B2130028
28	Washer	1	B1086108	1	B1086108	1	B1086108	1	B1086108
29	Truss Hd. Screw	1	M169028	1	A8076048	1	M169028	1	A8076048
30	Screw (not shown)	—	—	—	—	2	C301128	2	C301128
*	Kit	1	VM4K-1	1	VM4K-1	1	VM4K-1	1	VM4K-1

### IMPORTANT – USER SAFETY AND PROTECTION

In setting up systems to fit your operations, care must be taken to select the proper components and design to insure appropriate integration with your operations and existing equipment and that all safety measures have been taken to avoid the risk of personal injury and property damage from your application or system.

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*NOTE: Orders for parts cannot be filled unless both model and serial number with prefix imprinted on nameplate are given.*

PARTS AND SERVICE	WARRANTY	WARRANTY RETURN PROCEDURE
<p>For quality workmanship and genuine ENERPAC parts, select a Franchised ENERPAC Service Center for your repair needs.</p> <p>Only repairs performed by a Franchised Service Center displaying the official ENERPAC Franchised sign are backed with full factory warranty.</p> <p>The Classified Section in your Phone Book lists your nearest Franchised Service Center.</p>	<p>ENERPAC warrants its products against defects in workmanship and materials for 90 days from date of delivery to user. Chain is not warranted.</p> <p>Warranty does not cover ordinary wear and tear, abuse, misuse, overloading, altered products or use of improper fluid.</p>	<p>When question of warranty claim arises, the user should send his unit to the nearest ENERPAC Franchised Service Center for inspection, transportation to be prepaid and evidence of purchase date furnished. If the claim comes under the terms of our warranty, the Franchised Service Center will REPAIR OR REPLACE PARTS AFFECTED, and return prepaid.</p>

# ENERPAC®

AN APPLIED POWER  INDUSTRY

701 137

ENERPAC, BUTLER, WISCONSIN 53007 DIVISION OF APPLIED POWER INC. TELEPHONE (414) 781-6600 TELEX 026-682

DOCUMENT EN-OP-001, Rev. —

PRINTED IN U.S.A. MARCAS REGS.

Sheet 29

L-603-1 776

APPENDIX D

ENERPAC PNEUMATIC/HYDRAULIC  
POWER SUPPLY DATA SHEETS

701 138

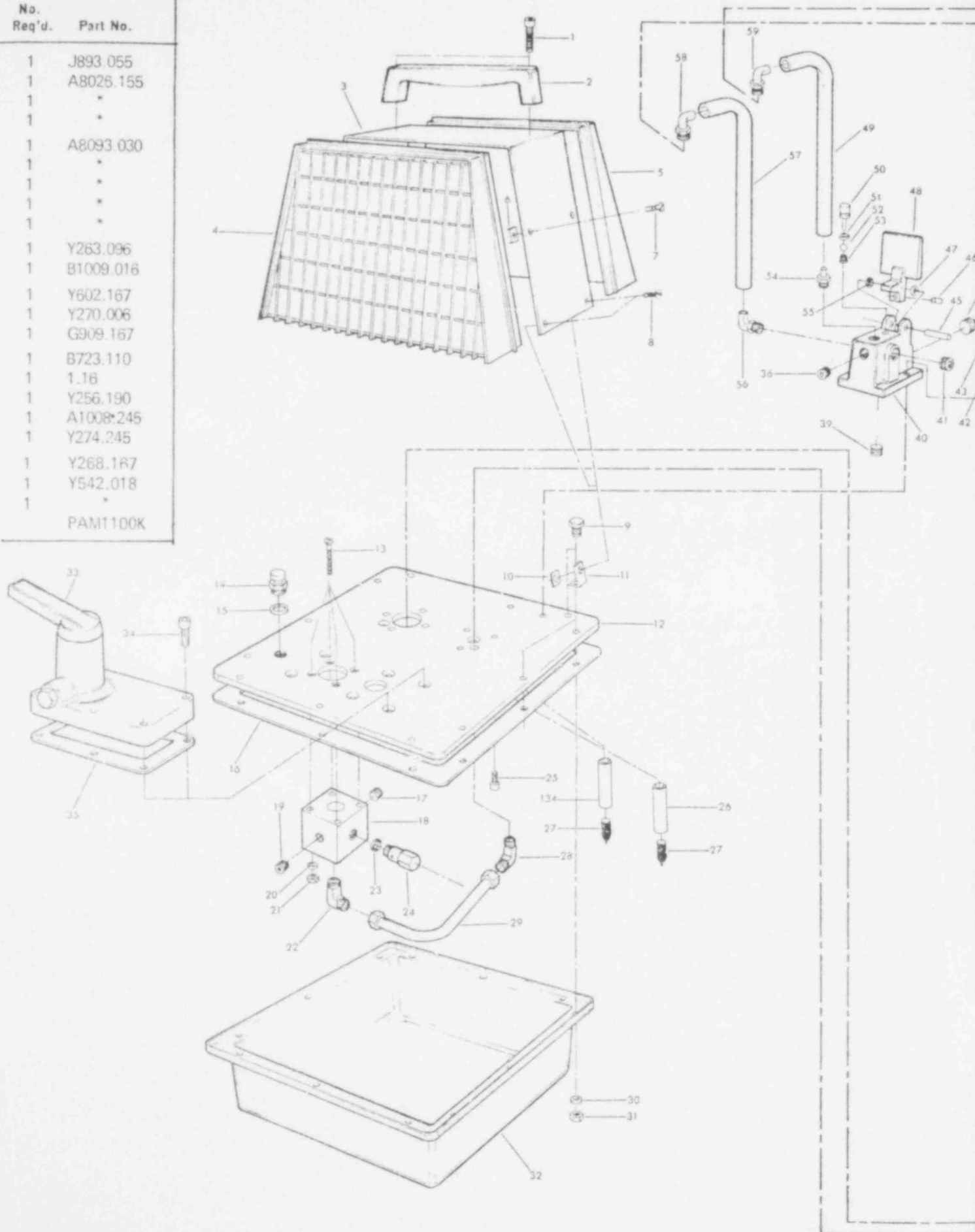


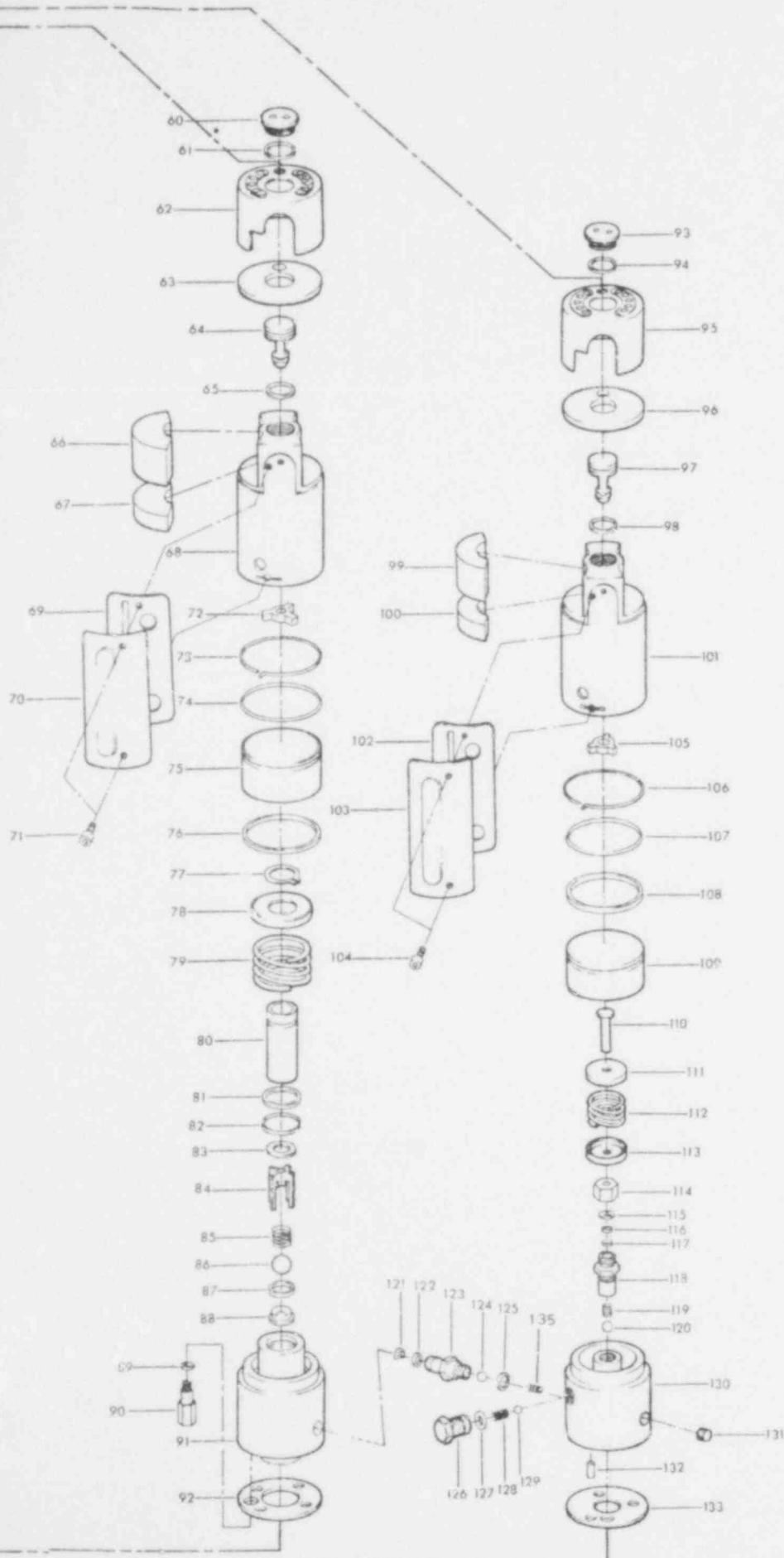
# PARTS LIST

Item No.	Description	No. Req'd.	Part No.	Item No.	Description	No. Req'd.	Part No.	Item No.	Description
1	Soc. Hd. Cap Screw	2	F659.028	58	90° Male Coupling	2	Y291.034	114	Cylinder Nut
2	Handle Assy.	1	Y154.070	59	90° Male Coupling	2	Y291.034	115	Bearing
3	Cover Sub-Assy.	1	Y262.950	60	Plug - Air Servo	1	A8054.006	116	Back-Up Washer
4	Grill	1	Y148.024	61	"O" Ring	1	*	117	"O" Ring
5	Grill	1	Y660.024	62	Air Circuit Cover	1	B8028.098	118	Cylinder
6	Speed Nut	4	M748.055	63	Filter	1	Y724.018	119	Spring
7	Machine Screw	4	F866.028	64	Stem	1	A8002.052	120	Ball
8	Machine Screw	4	F866.028	65	"O" Ring	1	*	121	"O" Ring
9	Hex Hd. Cap Screw	12	B1003.046	66	Muffler	2	Y571.018	122	Back-Up Washer
10	Speed Nut	4	M783.055	67	Muffler	2	Y572.018	123	Connector
11	Bracket	4	M780.111	68	Body - Air Circuit	1	Y271.264	124	1/8 Ball
12	Cover	1	Y251.098	69	Gasket	1	*	125	Gasket
13	Flat Hd. Screw	4	Y708.028	70	Cover	1	C82.098	126	Plug
14	Air Vent Valve	1	B171.900	71	Soc. Hd. Cap Screw	2	B1322.028	127	Gasket
15	Gasket	1	B159.167	72	Seal	1	*	128	Spring
16	Gasket	1	*	73	Ret. Ring	1	*	129	Ball
17	Pipe Plug	2	A1007.245	74	"O" Ring	1	*	130	Body - Hyd. Circ
18	Adaptor Block	1	Y659.038	75	Piston	1	Y398.051	131	Pipe Plug
19	Pipe Plug	2	A1007.245	76	"U" Ring	1	*	132	Plug
20	Lock Washer	4	P45.139	77	Ret. Ring	1	A8063.049	133	Gasket
21	Hex Nut	4	CB9.55	78	Washer	1	A8041.108	134	Filter Pipe
22	90° Male Elbow	1	C765.096	79	Spring	1	A8079.110	135	Spring
23	Gasket	1	B159.167	80	Plunger	1	A8204.040	*	Kit
24	Relief Valve	1	P181.190-2	81	"U" Cup	1	*		
25	Hex Soc. Hd. Cap Screw	7	B1004.028	82	"O" Ring	1	*		
26	Filter Pipe	1	Y541.018	83	Expan. Plug Wash.	1	Y769.108		
27	Screen	2	*	84	Spring Guide Assy.	1	A8416.900		
28	Male 45° Elbow	1	Y543.291	85	Spring	1	*		
29	Tube Assy.	1	Y544.26S	86	Ball	1	B1021.016		
30	Lock Washer	12	B1015.066	87	Oil Seal	1	A8026.476		
31	Hex Nut	12	B1001.123	88	Insert Seat	1	A8003.290		
32	Reservoir	1	Y516.025	89	Gasket	1	S3.037		
33	2-Way Valve Assy.	1	C792.900	90	Safety Valve Assy.	1	G586.900		
34	Hex Soc. Hd. Cap Screw	6	B1349.028	91	Body - Hyd. Circuit	1	Y78.190		
35	Gasket	1	C336.161	92	Gasket	1	Y253.167		
36	Flush Plug	1	A1007.245	93	Plug - Air Servo	1	A8054.006		
39	Flush Plug	1	A1008.245	94	"O" Ring	1	*		
40	Air Manifold	1	Y414.190	95	Air Circuit Cover	1	B8028.098		
41	Flush Plug	1	A1009.245	96	Filter	1	Y724.018		
42	Washer	2	M494.108	97	Stem	1	A8002.052		
43	Hex Soc. Cap Screw	2	B1328.028	98	"O" Ring	1	*		
44	Plug	1	A8035.006	99	Muffler	2	Y571.018		
45	Pin	1	B1132.057	100	Muffler	2	Y572.018		
46	Soc. Set Screw	1	Y372.028	101	Body - Air Circuit	1	Y272.264		
47	Wave Washer	2	Y417.108	102	Gasket	1	*		
48	Handle	1	Y411.070	103	Cover	1	C82.098		
49	Air Hose	1	Y293.646	104	Soc. Hd. Cap Screw	2	B1322.028		
50	Spindle	1	Y370.030	105	Seal	1	*		
51	"O" Ring	1	*	106	Ret. Ring	1	*		
52	Ball	1	*	107	"O" Ring	1	*		
53	Spring	1	*	108	"U" Ring	1	*		
54	Male Coupling	1	M317.034	109	Piston	1	B729.578		
55	Wave Washer	2	Y417.108	110	Plunger	1	A8136.040		
56	90° Male Coupling	1	Y662.034	111	Washer	1	A8009.108		
57	Air Hose	1	Y292.646	112	Spring	1	A8032.110		
				113	Washer	1	A8011.108		

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No. Req'd.	Part No.
1	J893.055
1	A8025.155
1	*
1	*
1	A8093.030
1	*
1	*
1	*
1	Y263.096
1	B1009.016
1	Y602.167
1	Y270.006
1	G909.167
1	B723.110
1	1.16
1	Y256.190
1	A1008.245
1	Y274.245
1	Y268.167
1	Y542.018
1	*
	PAM1100K





# INSTRUCTIONS

## TROUBLE SHOOTING

### PUMP FAILS TO DELIVER OIL

#### Cause

- A. Fluid low in reservoir
- B. Intake pipe or filter plugged
- C. Air leak in system. Pump unable to prime, causing noise and erratic action of components
- D. Oil of too heavy viscosity
- E. Wrong direction of pump shaft rotation
- F. Dirt in pump

#### Solution

- Check oil level and fill
- Clean filter
- Seal all air leaks
- See oil specifications
- Must be reversed to prevent damage to pump, due to lack of lubrication
- Clean pump

### PUMP NOISE

#### Cause

- A. Intake line or intake filter has restriction
- B. Air leaks
- C. Worn or broken parts

#### Solution

- Clean; be sure lines are fully open
- Pour oil on joints to check for leaks
- Replace

### OIL LEAKAGE AROUND PUMP

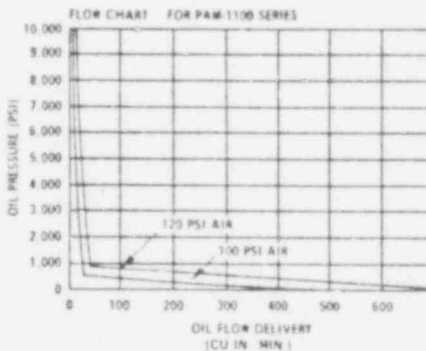
#### Cause

- A. Shaft packing worn
- B. Broken or loose part

#### Solution

- Replace
- Check and replace or tighten

Automatic pressure make-up feature for PAM-1100 Series Air Pumps — for sustained pressure cycle. Pumps hold pressure for prolonged periods and automatically make up any losses due to pressure drops in the circuit. Simply adjust the air regulator (RFL-100) to correspond with the desired circuit pressure and secure the treadle or push button in advance position. With the air supply pressure continuously applied to the air motor, the pump will automatically cycle whenever circuit pressure drops below the pump stall pressure.



## Other ENERPAC Air-Operated Pumps



PAM-30 SERIES



PA-600 SERIES



PA-130

**NOTE:** Orders for parts cannot be filled unless both model and serial number with prefix imprinted on nameplate are given.

#### PARTS AND SERVICE

For quality workmanship and genuine ENERPAC parts, select a Franchised ENERPAC Service Depot for your repair needs.

Only repairs performed by a Franchised Service Depot displaying the official ENERPAC Franchised sign are backed with full factory warranty.

The Classified Section in your Phone Book lists your nearest Franchised Service Depot.

#### WARRANTY

ENERPAC warrants its products against defects in workmanship and materials for 90 days from date of delivery to user. Chain is not warranted.

Warranty does not cover ordinary wear and tear, abuse, misuse, overloading, altered products or use of improper fluid.

#### WARRANTY RETURN PROCEDURE

When question of warranty claim arises, the user should send his unit to the nearest ENERPAC Franchised Service Depot for inspection, transportation to be prepaid and evidence of purchase date furnished. If the claim comes under the terms of our warranty, the Franchised Service Depot will REPAIR OR REPLACE PARTS AFFECTED and return prepaid.

# ENERPAC®

AN APPLIED POWER INDUSTRIES COMPANY

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ENERPAC, BUTLER, WISCONSIN 53007 DIVISION OF APPLIED POWER INDUSTRIES, INC. TELEPHONE (414) 781-8600 TELEX 026-682

POOR CRANKING



APPENDIX F

Transportation Systems

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DOCUMENT

REV.

SHEET

## CHEM-NUCLEAR TRANSPORT CONTAINER INVENTORY

Page 1

CNSI Transport Container	Classification	Dimensions	PB Shielding Equivalence (inches)	Drum (55 gal) Capacity	Liner Capacity (Ft <sup>3</sup> )	*Maximum Radlevels (R/hr)	*Average Radlevels (R/hr)	Approximate Container Emp.Wt. (lbs)	Payload (lbs)
CNS 0-4 (LL-28-4)	Type B USA/6275/B( )	14 7/8"Ø x 40"	11.50	N/A	3.5	50,000+	50,000+	28,150	1,850
CNS 1-8	Type B USA/9070/B	24"Ø x 34-1/2"	Nil	1	8	0.200	0.20	200	550
CNS 1-13G	Type B USA/9044/B( )F	26-1/2"Ø x 54"	6.20	1	13	5,000+	5,000+	23,250	5,000
CNS 1-13C	Type B USA/9081/B( )	26-1/2"Ø x 54"	5.7	1	13	1,000+	1,000+	20,950	5,000
CNS 3-55 (LL-57-65)	Type B USA/5305/B( )F	36"Ø x 116-3/4"	7.00	3	60	10,000+	10,000+	57,000	9,200
CNS 4-45	Type B USA/6375/B( )F	26"Ø x 159"	6.5 - 7.5	4	45	10,000+	10,000+	57,050	10,000
CNS 4-85	Type B USA/6244/B( )	46"Ø x 100"	3.38	4	38	100	50	40,300	5,700
CNS 6-75 (AL-33-90)	SPEC 7A USA/9108/A	53"Ø x 74-1/2"	4.00	6	85	170	150	31,000	10,300
CNS 6-80-1	Strong, Tight Container, Type A Quantities Only**	59"Ø x 58" (59"Ø x 60-1/4")	5.00	6	85	≥1 R/hr @ 3 Ft.	≥1 R/hr @ 3 Ft.	47,500 Est	No Limit
CNS 6-80-2	SPEC 7A USA/9111/A	59"Ø x 58"	5.00	4	85	500+	500+	44,000	7,500
CNS 6-80-B	In Licensing	59"Ø x 58"	5.00	4	85	500+	500+	47,500	7,500
CNS 6-101	SPEC 7A USA/9105/A	34" x 40" x 156"	3.28	6	N/A	60	30	53,400 Inc. Trailer	6,000
CNS 7-100	SPEC 7A USA/9113/A	75-1/2"Ø x 40-3/4"	3.50	7	87	150	100	35,000	7,000
CNS 8-120 (LL-50-100)	Type B USA/6601/B( )	62"Ø x 75"	4.50	3	126	250+	250+	58,000	12,000
CNS 12-180 (AL-31-12D)	Strong, Tight Container, Type A Quantities Only**	54" x 40" x 147"	2.00	12	N/A	≥1 R/hr @ 3 Ft.	≥1 R/hr @ 3 Ft.	31,000	No Limit
CNS 14-190 (BC-48-220)	Type B USA/5026/B( )	73"Ø x 38-1/4"	2.75	14	195	15	5	60,280	10,720
CNS 14-195L	Strong, Tight Container, Type A Quantities Only**	77"Ø x 80"	2.00	14	200	≥1 R/hr @ 3 Ft.	≥1 R/hr @ 3 Ft.	31,550	17,700

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Rev. 1

## CHEM-NUCLEAR TRANSPORT CONTAINER INVENTORY

Page 2

CNSI Transport Container	Classification	Dimensions	PB Shielding Equivalence (inches)	Drum (55 gal) Capacity	Liner Capacity Ft <sup>3</sup>	*Maximum Radlevels R/hr	*Average Radlevels R/hr	Approximate Container Emp.Wt.(lbs)	Payload (lbs)
CNS 14-195H	SPEC 7A USA/9094/A	77"Ø x 80"	2.75	14	200	25	15	39,650	16,850
CNS 14-220L (AL-27-240)	Strong, Tight Container, Type A Quantities Only**	77-1/2"Ø x 89"	1.75	14	200	➤ 1 R/hr @ 3 Ft.	➤ 1 R/hr @ 3 Ft.	33,200	No Limit
CNS 14-220H (AL-27-240)	Strong, Tight Container, Type A Quantities Only**	75"Ø x 87-3/4"	2.75	14	N/A	➤ 1 R/hr @ 3 Ft.	➤ 1 R/hr @ 3 Ft.	39,900	No Limit
CNS 15-160S	Strong, Tight Container, Type A Quantities Only**	124" x 35" x 72"	2.50	15	2 @ 83	➤ 1 R/hr @ 3 Ft.	➤ 1 R/hr @ 3 Ft.	42,000	No Limit
CNS 15-160B	Type B USA/G144/B	126" x 36" x 75"	1.50	15	2 @ 83	5	1	37,000	5,000 No Limit
CNS 18-450	SPEC 55	86" x 86" x 100"	1-2	18	308	5	1	36,950	No Limit
CNS 21-300	SPEC 7A USA/9096/A	83"Ø x 109"	1.50	21	322	5	1	30,200	27,250
SHIELDED VAN	CLOSED, TRANSPORT VEHICLE	7'5" x 40" x 9'	0.50	75	N/A	1	0.500	28,000	26,000
CNS BTC-C	BULK SHIPMENT ONLY	Dump-type vehicles for the transport of bulk LSA, radioactive wastes - 620 ft <sup>3</sup> capacity, 36,000+ lb payload capacity (depending on various state limits). Dimensions - 18' x 52" x 84"							
CNS BTC-S	STC	Closed box-type containers for the shipment of bulk, LSA, radioactive wastes - 360 ft <sup>3</sup> capacity, 40,000+ lb payload capacity (depending on various state limits). Dimensions: without inserts - 78" x 180" x 52"							

\*Based on Cobalt 60 gamma energy, these Rad levels are generally found to be conservative, however, equivalent shielding should be carefully evaluated in relation to the specific isotopes involved.

\*\*These casks are considered "strong, tight containers" and radiation levels of the contents shall not exceed 1 R/hr @ 3 feet from the unshielded surface. The 6-80-1 and 14-195L casks are currently in licensing for Spec 7A certification.

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CHEM-NUCLEAR SYSTEMS, INC.

TRANSPORT EQUIPMENT DESCRIPTION

REGULAR VANS

Standard forty (40) foot, closed trailers are provided for very low level radwaste. Approximately 43,000 pounds of drummed or otherwise properly packaged radwaste may be transported per shipment. Radwaste radiating up to about 200 mr/hr can be readily transported by way of regular van.

CNS 0-4 (LL-28-4) TYPE B TRANSPORT CASK

The CNS 0-4 (LL-28-4) Cask is a lead and steel shipping container certified (U.S. N.R.C. Certificate of Compliance No. 6275) for shipments of Type "B", Large Quantity, and Fissile Radioactive materials. Suitable for underwater loading, this 28,000 pound cask can accommodate approximately three and one-half (3.5) cubic feet of waste material and it provides 11.5 inches of lead shielding.

CNS 1-8 TYPE B TRANSPORT CASK

The CNS 1-8 Cask is a steel and polyurethane foam shipping container certified (U.S. N.R.C. Certificate of Compliance No. 9070) for Type "B" shipments of radioactive materials. The 1-8 provides essentially no shielding and can accommodate one (1)-55 gallon drum or approximately nine (9) cubic feet of otherwise properly-packaged radwaste material.

CNS 1-13G TYPE B TRANSPORT CASK

The top-loading CNS 1-13G Cask is designed to transport one (1) 55-gallon drum or one (1) thirteen (13) ft<sup>3</sup> liner. This cask provides 6.2 inches of lead equivalent shielding, with radiation levels of 5000 R/hr being readily shielded. Underwater loading capabilities are designed therein.

CNS 1-13C TYPE B TRANSPORT CASK

The top-loading CNS 1-13C Cask is similar to the 1-13G except that the thermal shield is integral to the 1-13C cask body. Since no additional overpack is provided, shielding is reduced to approximately 5.7 inches of lead equivalence for the CNS 1-13C.

CNS 3-55 (LL-57-65) TYPE B TRANSPORT CASK

The CNS 3-55 (LL-57-65, Vandenburg, Cask is a lead and steel cask certified (U.S. N.R.C. Certificate of Compliance No. 5805) for shipments of Type "B", Large Quantity and Spent Nuclear Fuel. With inside dimensions of 36 inches in diameter and 116 inches in height, this underwater loading cask can accommodate three (3) standard 55-gallon drums or a 60 cubic feet capacity disposable liner. The cask weighs 57,000 pounds and provides the equivalent shielding of seven (7) inches of lead. The CNS 3-55 Cask is suitable for use with either the redundant crane or dashpot type of cask drop protection system.

#### CNS 4-45 TYPE B TRANSPORT CASK

The top-loading CNS 4-45 Cask is specifically designed for the transportation and shielding of spent fuel. The cask's large internal capacity (45 ft<sup>3</sup>) and lead shielding equivalence make it readily suited, however, for the transport of irradiated reactor hardware. Four (4) drums or one (1) forty-five (45) cubic foot liner may be readily contained. Lead shielding equivalence ranges from six and one-half (6.5) to seven and one-half (7.5) inches.

#### CNS 4-85 TYPE B TRANSPORT CASK

The top-loading CNS 4-85 Cask is designed to transport four (4) 55-gallon drums or one (1) eighty-eight (88) ft<sup>3</sup> liner. This cask provides 3.38 inches of lead equivalent shielding and is especially useful in the transport of 50 - 100 R/hr resins and/or other solidified material.

#### CNS 6-75 (AL-33-90) SPEC 7A TRANSPORT CASK

The CNS 6-75 (AL-33-90) Cask is a lead and steel cask for shipping solid high level radioactive waste materials. The cask weighs 31,000 pounds and provides the equivalent shielding of four (4) inches of lead. With inside dimensions of 53" in diameter and 74" in height, this cask can accommodate six (6) standard 55-gallon drums in two (2) palletized tiers of three (3), or a 75 cubic foot capacity disposable liner. Approved for LSA material in greater than Type "A" quantities. Certificate of Compliance for Type "B" quantities, pending.

#### CNS 6-80-1 TRANSPORT CASK

The top-loading CNS 6-80-1 transport cask is designed to transport radwaste radiating up to about 500 R/hr. Six (6) 55-gallon drums of radwaste may be readily transported therein, four (4) vertical and two (2) horizontal. Also, one eighty-five (85) cubic feet liner may be placed therein. This cask is currently classified as a "strong, tight container" and licensing is pending for greater than Type "A" quantities of LSA radwaste material.

#### CNS 6-80-2 SPEC 7A TRANSPORT CASK

The top-loading CNS 6-80-2 transport cask is designed to transport radwaste radiating up to about 500 R/hr and can readily accommodate underwater loading. Six (6) 55-gallon drums of radwaste may be readily transported therein, four (4) vertical and two (2) horizontal. Also, one eighty-five (85) ft<sup>3</sup> disposable liner may be placed therein. A Certificate of Compliance for Type "B" quantities of radioactive materials is pending.

#### CNS 6-101 SPEC 7A TRANSPORT CASK

The self-loading CNS 6-101 Cask is designed to transport six (6) 55-gallon drums with radiation readings of up to approximately 60 R/hr. Approximately 3.28 inches of lead equivalent shielding is provided. This cask is especially useful where top-loading is not possible.

#### CNS 7-100 SPEC 7A TRANSPORT CASK

The top-loading CNS 7-100 transport cask is designed to contain seven (7) drums or one (1) 100 ft<sup>3</sup> liner with radiation levels up to 100 R/hr at the surface. By strategically locating drums with lower surface radiation levels within the CNS 7-100 cask, drums radiating up to between 125 and 150 R/hr may be readily shielded. Approximately 3.50 inches of lead equivalent shielding is provided.

#### CNS 8-120 (LL-50-100) TYPE B TRANSPORT CASK

The CNS 8-120 (LL-50-100) Cask is a lead and steel cask certified for shipments of Type "B" and large quantities of radioactive materials. The cask weighs 58,000 pounds and provides the equivalent shielding of 4-1/2 inches of lead. Certificate of Compliance No. 6601 has been issued by the U.S. N.R.C. to this cask. With internal dimensions of 62 inches in diameter and 75 inches in height, the cask can accommodate eight (8) standard 55-gallon drums, or a 124 cubic feet capacity disposable liner. Additionally, the cask is suitable for underwater loading.

#### CNS 12-180 (AL-31-12D) TRANSPORT CASK

The CNS 12-180 (AL-31-12D) Cask is a lead and steel rectangular cask designed to accommodate twelve (12) standard 55-gallon drums of Type "A" quantities or less of radwaste material. This cask is of the end-loading type equipped with roller conveyors compatible with most PWR and BWR drum loadout facilities. The cask weighs 31,000 pounds empty and provides the equivalent of two (2) inches of lead shielding.

#### CNS 14-190 TYPE B TRANSPORT CASK

The CNS 14-190 (BC-48-220) Cask is a steel and concrete cask with seven (7) inches of concrete, plus 2-1/2 inches of steel shielding. The cask weighs 60,280 pounds and has a volume of 220 cubic feet. Under Certificate of Compliance No. 5026, the cask is approved for shipments of Type "B" quantities of radioactive material. Inside dimensions are 73 inches in diameter and 88-1/4 inches in height, and can accommodate fourteen (14) standard 55-gallon drums or a 195 cubic foot disposable liner.

#### CNS 14-195L TRANSPORT CASK

The top-loading CNS 14-195L transport cask is designed to transport fourteen (14) drums or one (1) 200 ft<sup>3</sup> liner with radiation levels up to approximately 7 R/hr at the surface. Approximately 2.00 inches of lead equivalent shielding is provided. Although currently classified as a "strong, tight container", licensing is pending for greater than Type "A" quantities of LSA radwaste materials.

#### CNS 14-195H SPEC 7A TRANSPORT CASK

The top-loading CNS 14-195H transport cask is designed to contain fourteen (14) drums or one (1) 200 ft<sup>3</sup> liner with radiation levels up to approximately 20 R/hr at the surface. By strategically locating drums with lower surface radiation levels within the CNS 14-195H cask, drums radiating up to 25 R/hr may be readily shielded. Approximately 2.75 inches of lead equivalent shielding is provided.

#### CNS 14-220L TRANSPORT CASK

The CNS 14-220L (AC-27-240) Cask is a steel and concrete cask with seven (7) inches of concrete and 1/2 inch of steel shielding. The cask weighs 33,200 pounds and has a volume of 240 cubic feet. Inside dimensions are 77-1/2 inches in diameter and 89 inches in height. The cask can accommodate fourteen (14) 55-gallon drums of radioactive waste or a 200 ft<sup>3</sup> disposable liner.

#### CNS 14-220H TRANSPORT CASK

The CNS 14-220H (AC-27-240 with supplementary shielding) Cask is a steel and concrete cask with seven (7) inches of concrete, 0.75 inches of steel and one (1) inch of lead shielding. The cask weighs 39,900 pounds and has a volume of 228 cubic feet. Inside dimensions are 75-1/2 inches in diameter and 88 inches in height. The cask can accommodate fourteen (14) 55-gallon drums of radioactive waste.

#### CNS 15-160S TRANSPORT CASK

The top-loading CNS 15-160S transport cask is designed to transport fifteen (15) 55-gallon or two (2) eighty (80) ft<sup>3</sup> liners, with radiation levels up to 15 R/hr. Two and one-half inches of lead equivalent shielding is provided. Additionally, two (2) removable hatches are provided in the lid for ease in liner filling. The CNS 15-160S cask is classified as a "strong, tight container".

#### CNS 15-160B TYPE B TRANSPORT CASK

The top-loading CNS 15-160B transport cask is designed to transport fifteen (15) 55-gallon drums or two (2) eighty (80) cubic feet liners, with radiation levels up to 5 R/hr. One and one-half (1-1/2) inches of lead equivalent shielding is provided.

#### CNS 18-450 SPEC 55 TRANSPORT CASK

The top-loading CNS 18-450 Cask is designed to transport one (1) 308 ft<sup>3</sup> liner or eighteen (18) 55-gallon drums reading one (1) to five (5) R/hr at contact. One (1) inch of lead equivalence is provided in the cask with supplemental shield plates located on the cask's exterior with an additional one (1) inch of lead equivalence.

#### CNS 21-300 SPEC 7A TRANSPORT CASK

The top-loading CNS 21-300 Cask is designed to transport twenty-one (21) 55-gallon drums or one three hundred fifteen (315) ft<sup>3</sup> liner. The cask provides approximately one and one-half (1-1/2) inches of lead equivalent shielding with radiation levels of one (1) to five (5) R/hr being readily shielded.

#### SHIELDED VANS

Standard forty (40) foot, closed trailers are provided; however, 1/2 inch lead shielding, 35 inches in height, is placed around the internal perimeter and on the floor of the van. Up to 26,000 pounds of drummed or otherwise properly packaged radwaste may be transported per shipment. Radwaste radiating up to about 1 R/hr may be readily transported herein.

#### CNS BTC-C TRANSPORT CONTAINER

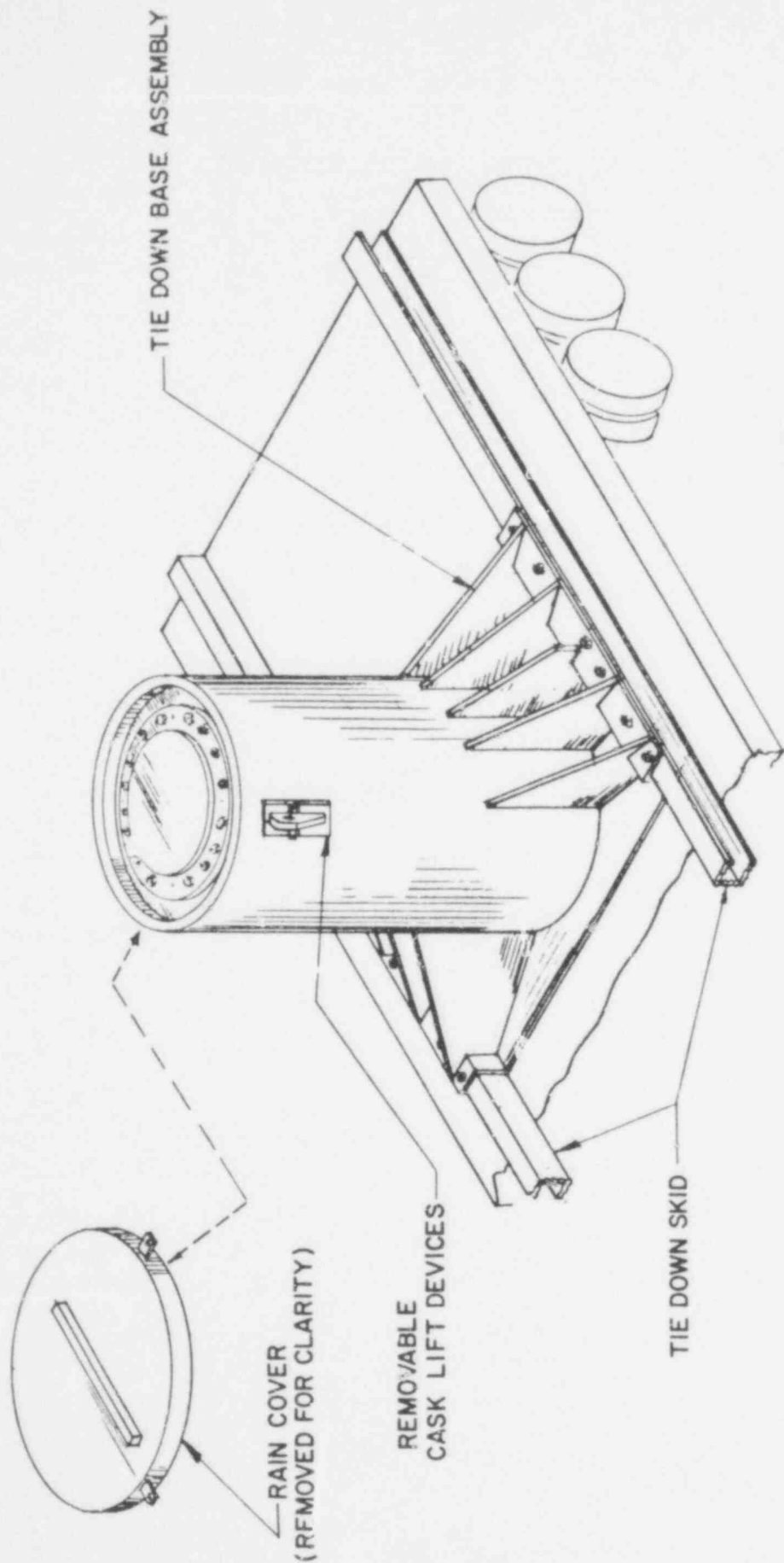
The top-loading CNS BTC-C containers are dump-type vehicles which may be utilized for the transport of bulk radioactive wastes. Each container has an available volume of 620 ft<sup>3</sup>. Up to 36,000 pounds of payload may be transported per shipment. An unlimited number of CNS BTC-C containers are available.

#### CNS BTC-S TRANSPORT CONTAINER

The top-loading CNS BTC-S strong, tight container may be utilized in the shipment of bulk or LSA radioactive wastes. 360 ft<sup>3</sup> of available space is provided with a payload of approximately 40,000 pounds. Each container consists of an outer shell with three (3) removable steel boxes therein, each of 120 ft<sup>3</sup> capacity. Three (3) CNS BTC-S containers are available.

#### SPECIAL CONTAINERS

Numerous one-time and specialty use casks and containers have been designed and fabricated by Chem-Nuclear Systems, Inc. Such containers are frequently required to accommodate odd-shaped or weighty objects.



LL-28-4  
 (CNS 0-4)

TRANSPORT CASK

ATCOR LL-28-4 (CNS 0-4)

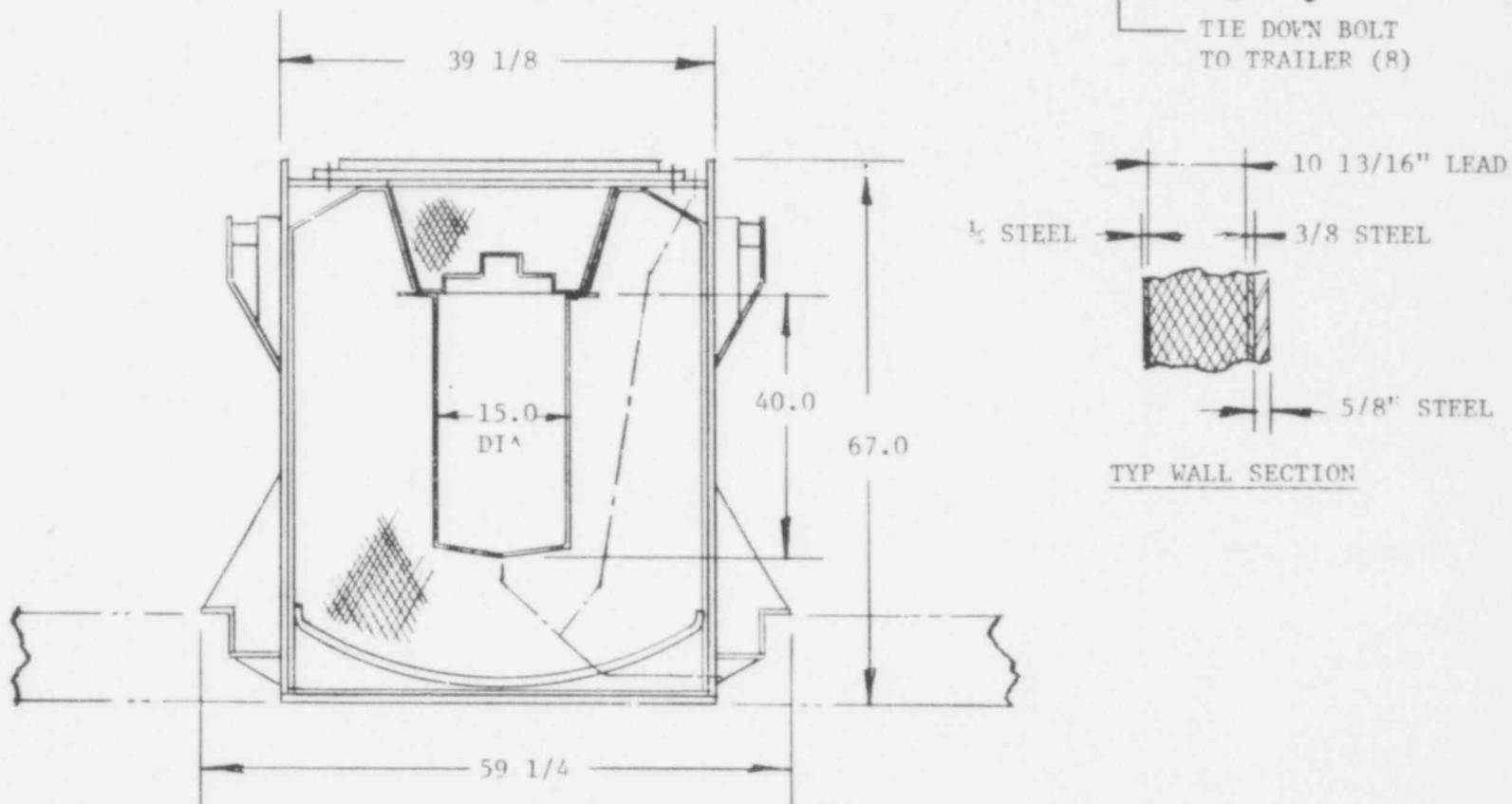
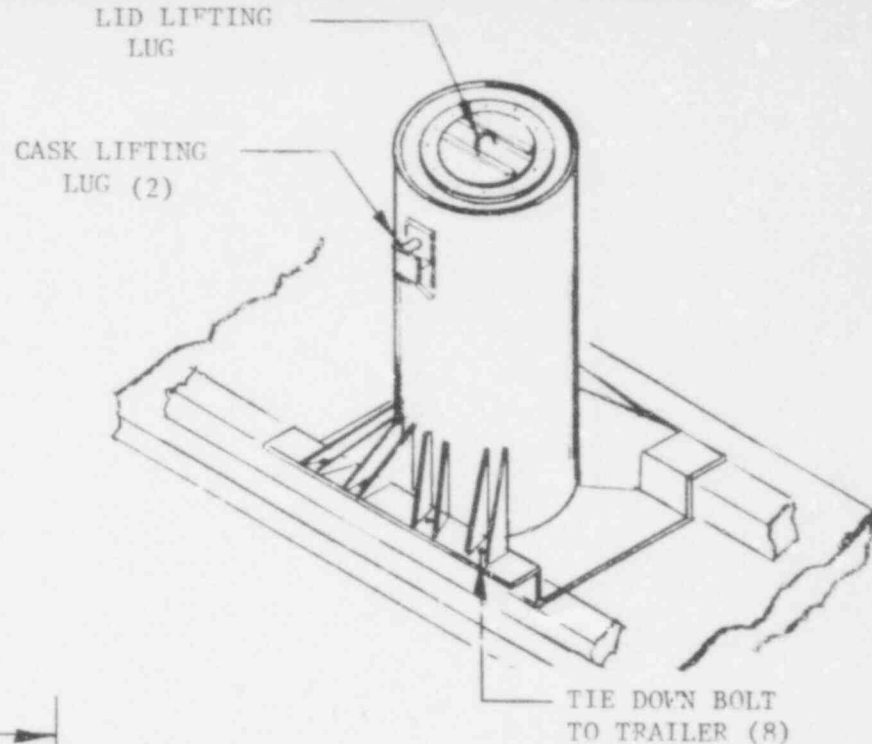
SHIELDING: 11 1/2 IN. LEAD EQUIV.

TYPE B - USA/6275/B

CAPACITY: (4) CU. FT.

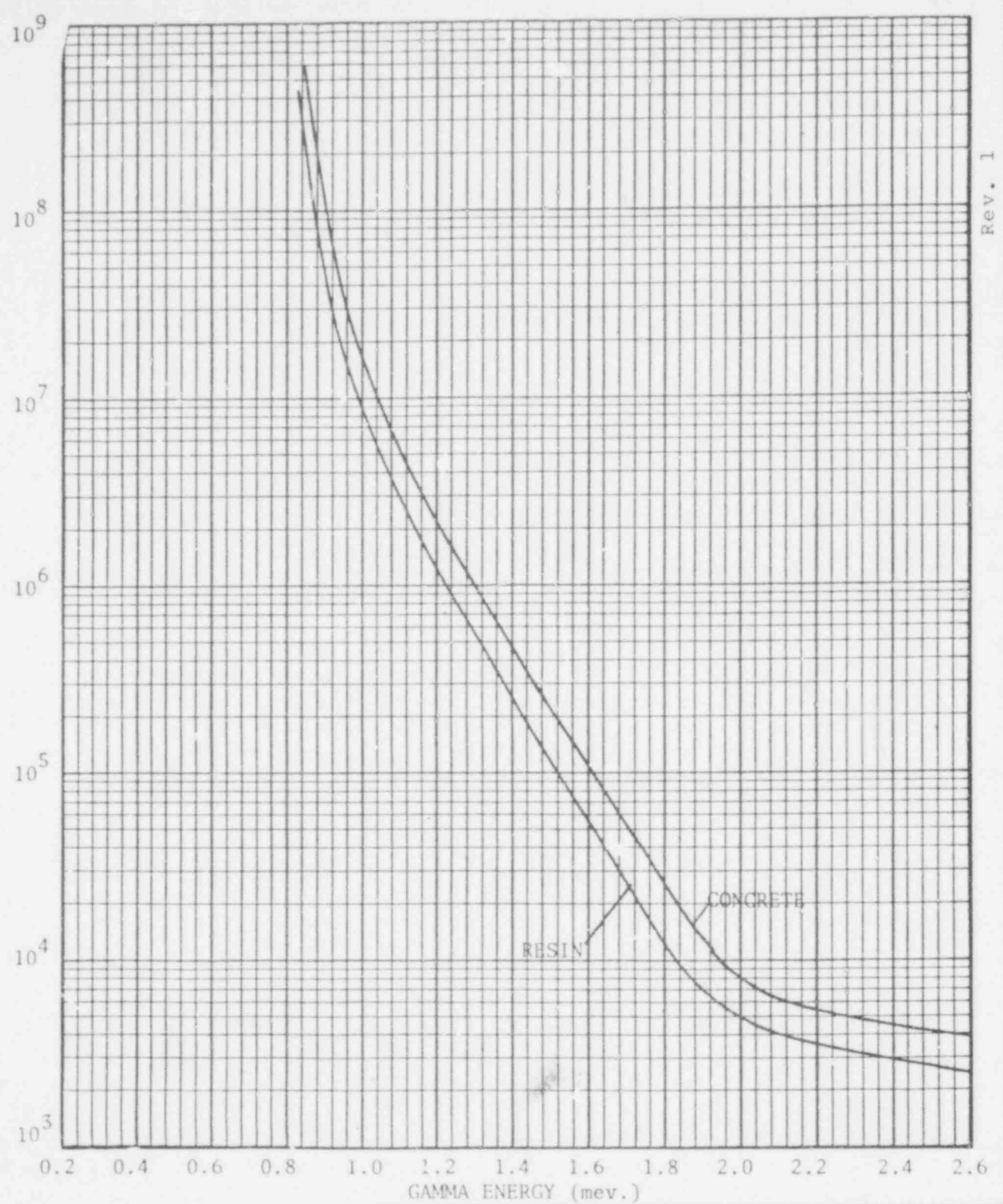
WEIGHT: GROSS WT. (EMPTY) 28,150 LBS.

CASK LID 1,600 LBS.



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\*\* CURIES/FT.<sup>3</sup>



### CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX

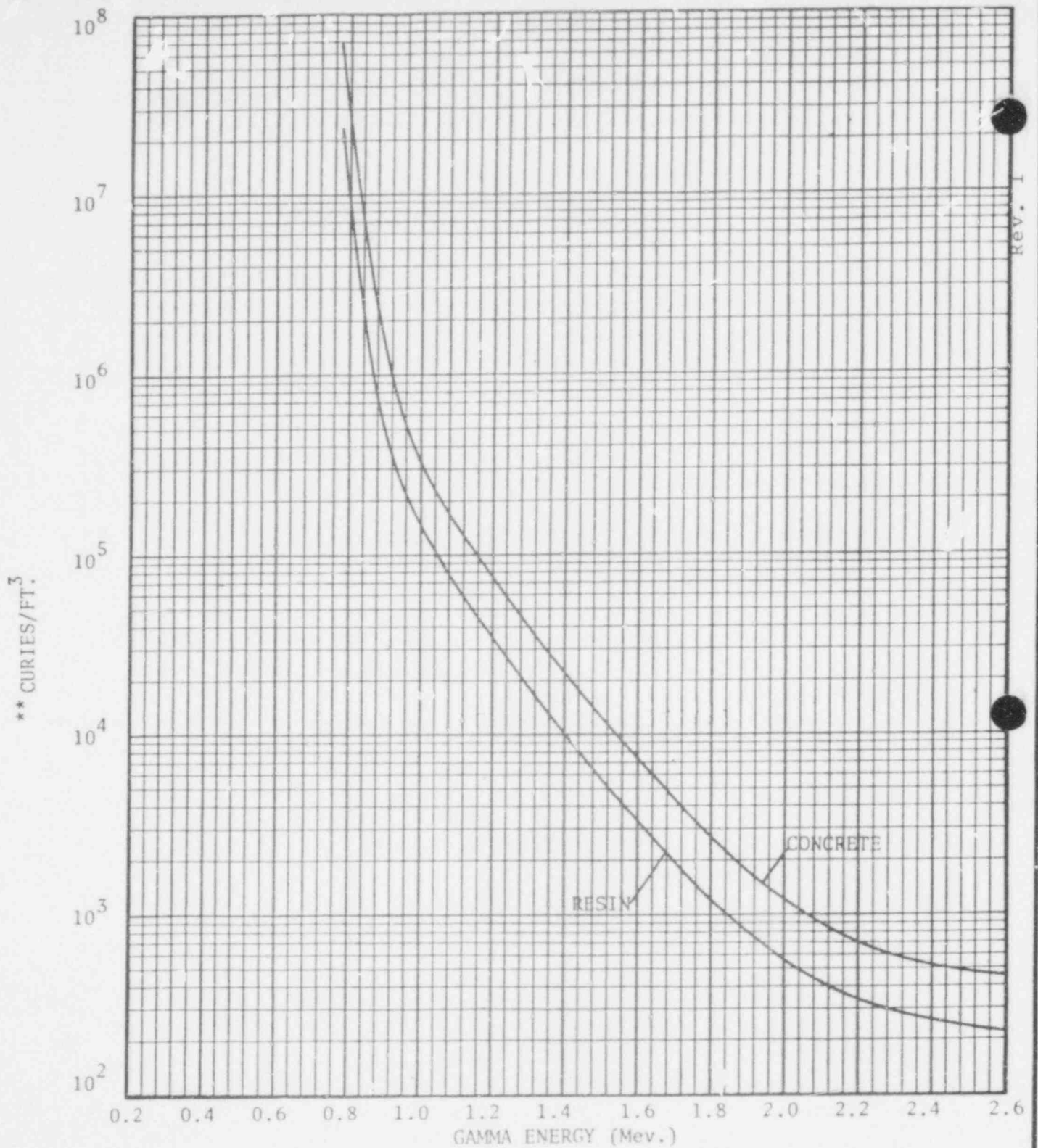
DOSE RATE AT 6 FEET FROM CASK IS 10 MR/HR

CASK: CNS 0-4  
 ( CASK LL- 28-4 ) 1 INCH STEEL, 10-13/16 INCHES  
 LEAD, 1/4 INCH STEEL  
 SHIELDING ON SIDE

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REV.	DATE	SHEET
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\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

## CHEM-NUCLEAR SYSTEMS, INC.

CASK: CNS 0-4  
(CASK LL-28-4) 2-5/8 INCHES STEEL,  
11-3/16 INCHES LEAD,  
1/4 INCH STEEL  
SHIELDING ON TOP 701 155

REV.

DATE

SHEET

CHEM-NUCLEAR SYSTEMS, INC.

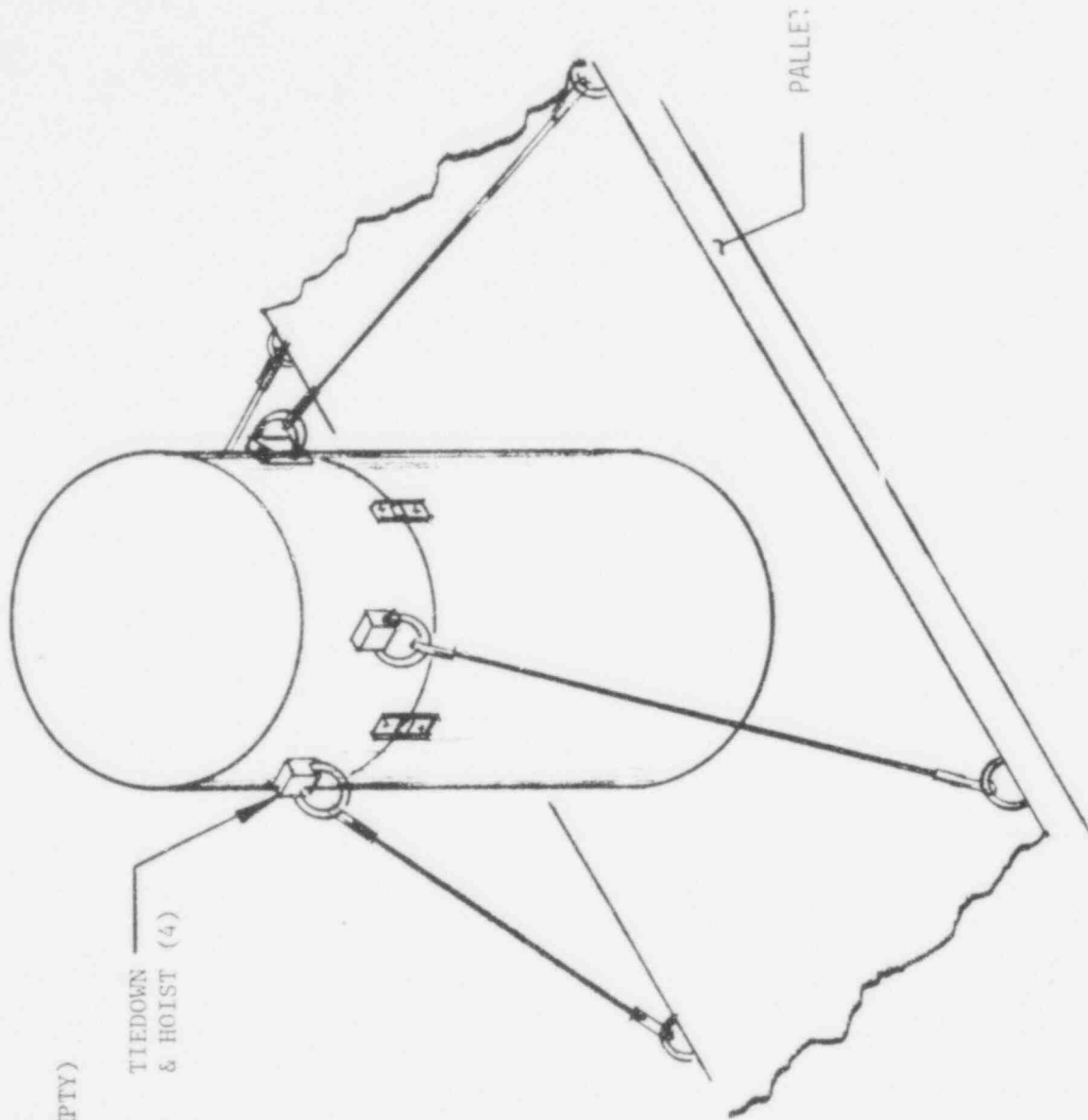
TRANSPORT CASK

MODEL CNS 1-8

TYPE B: USA/9070/B

CAPACITY: 9 CU. FT.

WEIGHT: GROSS WT. (EMPTY)  
200 LBS.



TIEDOWN  
& HOIST (4)

PALLE

CNS 1-8

CHEM-NUCLEAR SYSTEMS, INC.

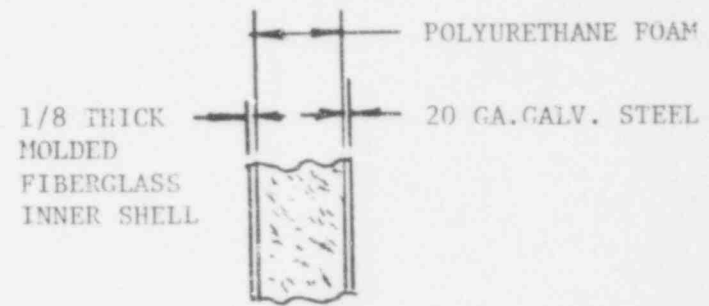
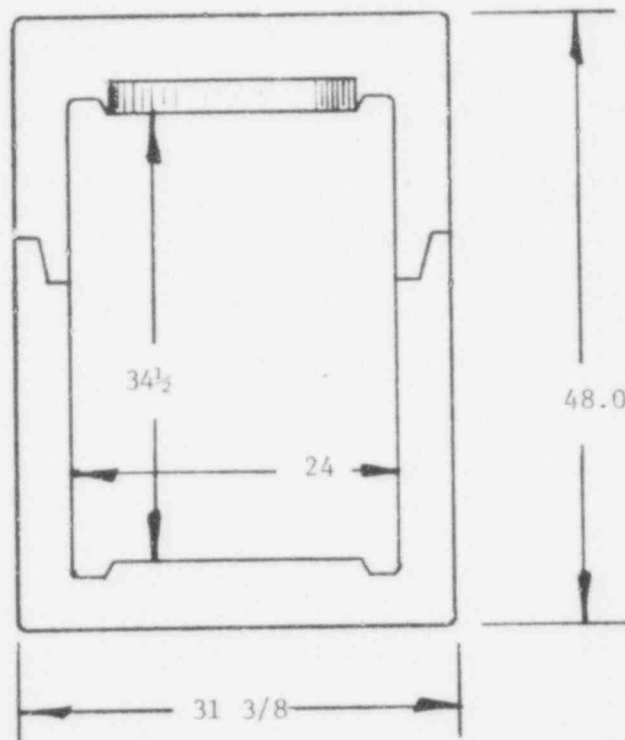
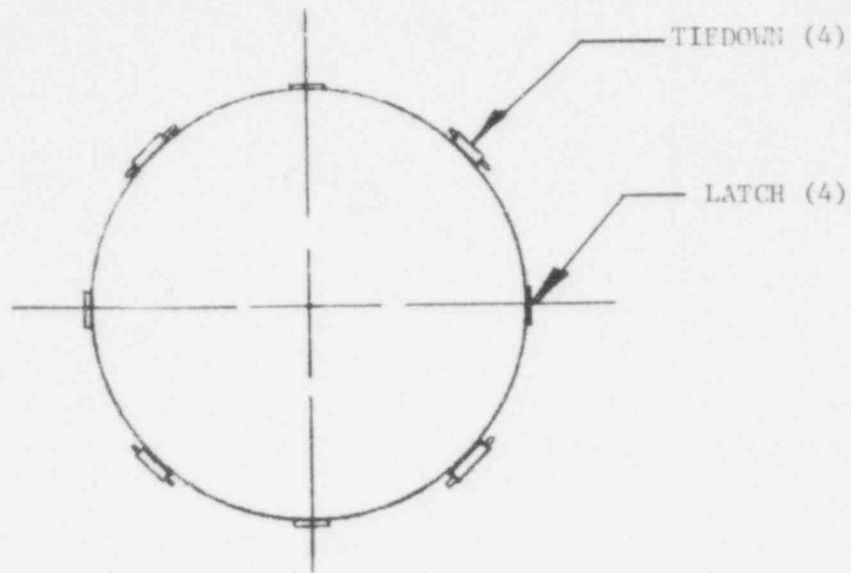
TRANSPORT CASK

MODEL CNS 1-8

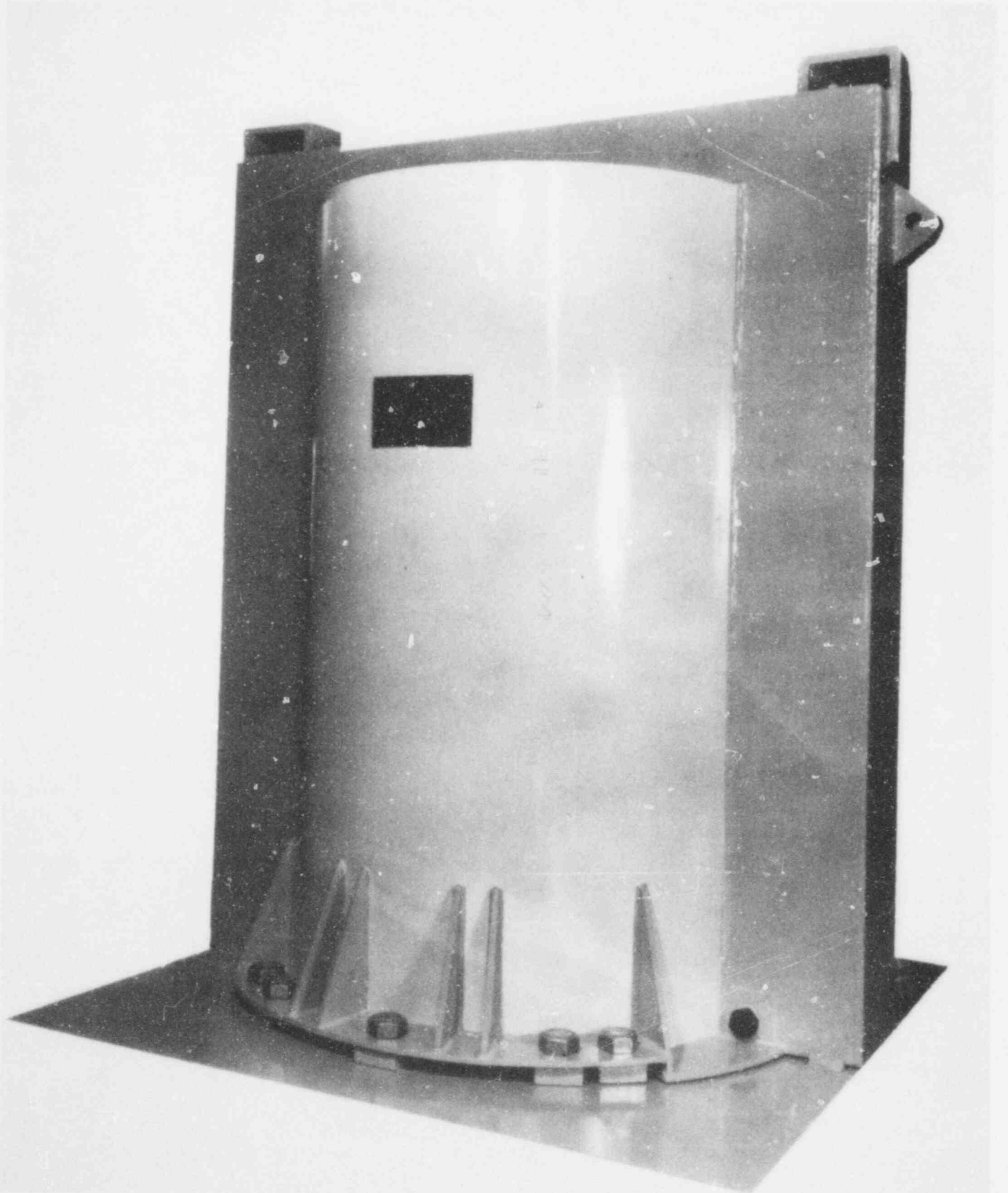
TYPE: USA/9070/B

CAPACITY: 9 CU. FT.

WEIGHT: GROSS WT. (EMPTY)  
200 LBS.



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**POOR ORIGINAL**

CHEM-NUCLEAR SYSTEMS, INC.  
CNS 1-13G

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**CHEM-NUCLEAR SYSTEMS, INC.**

CNS 1-13G (MODEL 1000)

SHIELDING: 6.2 IN. LEAD EQUIV.

U.S.N.R.C. PACKAGE IDENT NO. U.S.A./9044/B ( ) F

SEE U.S.N.R.C. CERTIFICATE OF COMPLIANCE NO. 9044  
FOR AUTHORIZED QUANTITIES OF VARIOUS TYPES OF MAT'L

WEIGHT

GROSS WEIGHT: 23,050 LBS (EMPTY)

CASK LID: 2,300 LBS

CASK: 19,950 LBS.

OVERPACK: 3,100 LBS.

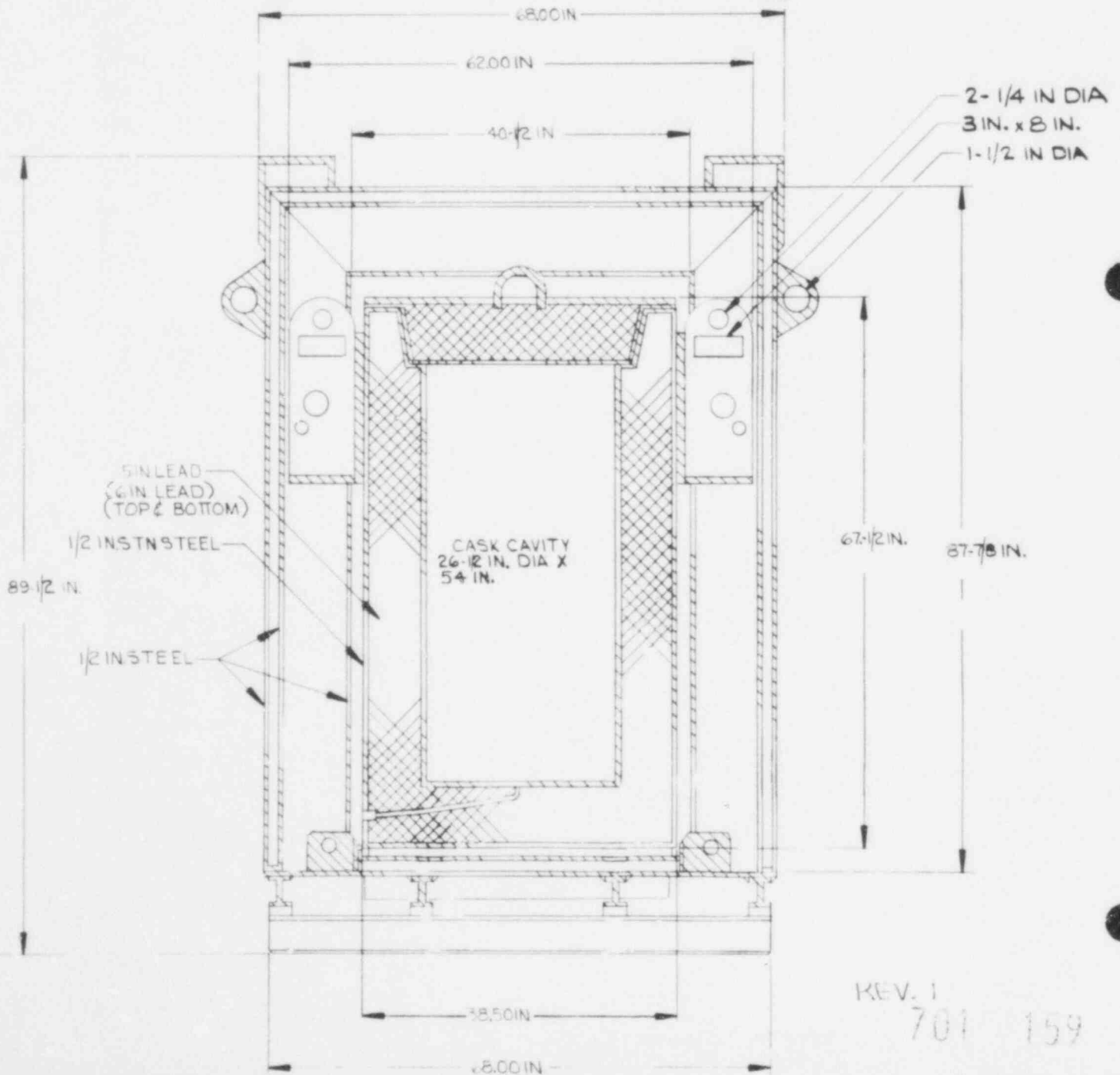
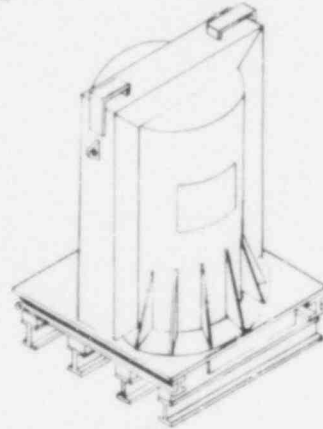
MODE OF TRANSPORTATION

MOTOR VEHICLE AND VESSEL

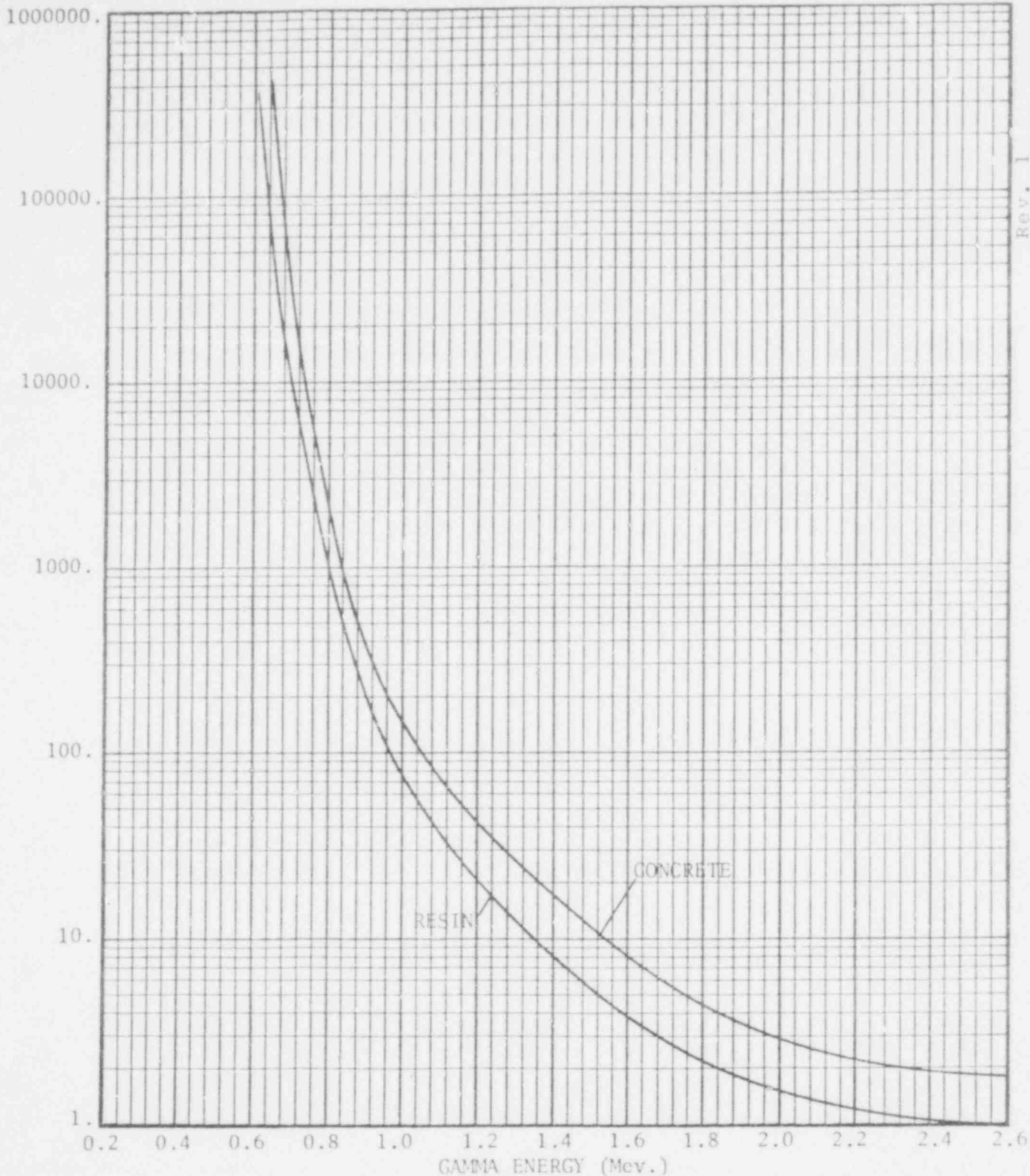
CAPACITY

(1) 55 GAL. DRUM OR

(1) 13 CU. FT. CONTAINER



\*\* CURIES/FT<sup>3</sup>



Rev. 1

## CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

CASK 1-13C 3/4 INCH STEEL, 5 INCHES LEAD,  
1/2 INCH STEEL

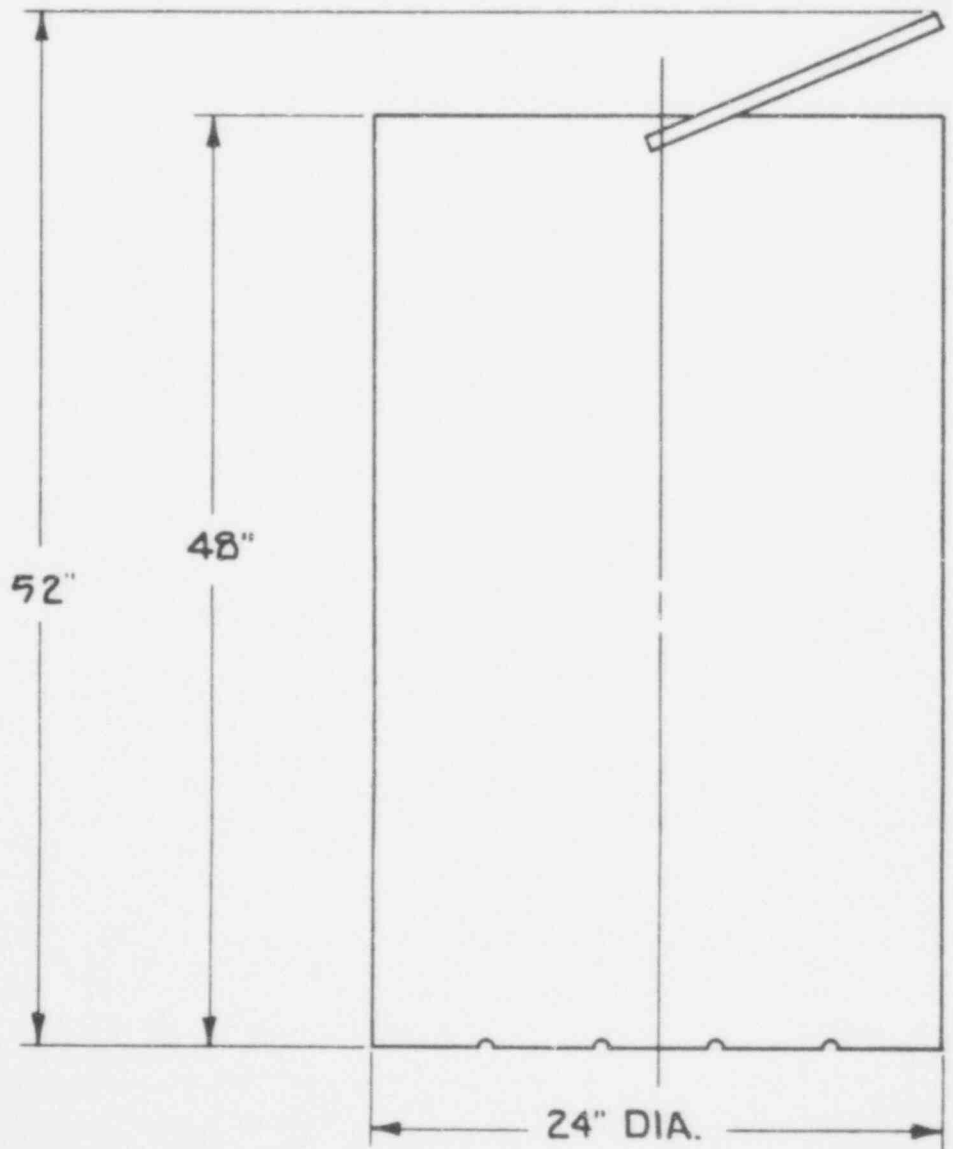
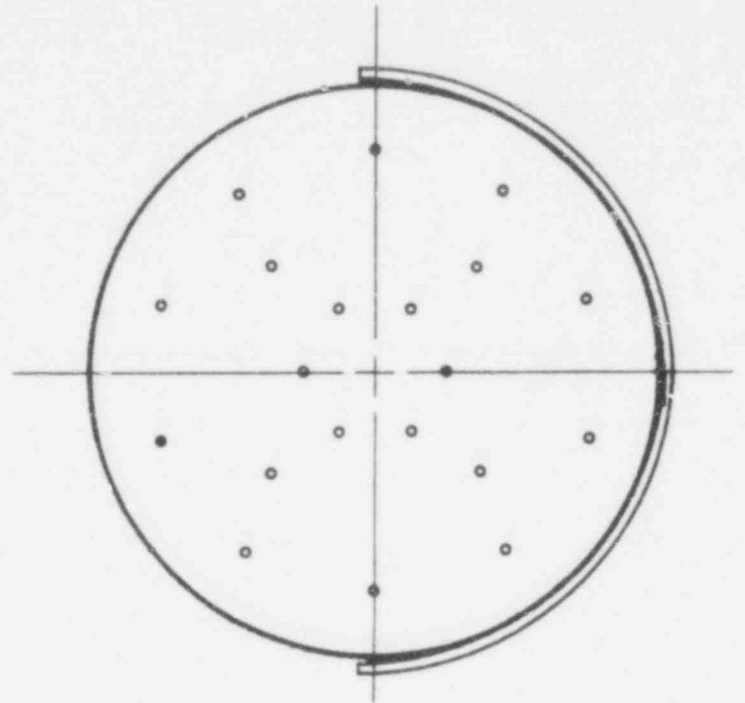
701 160

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DATE

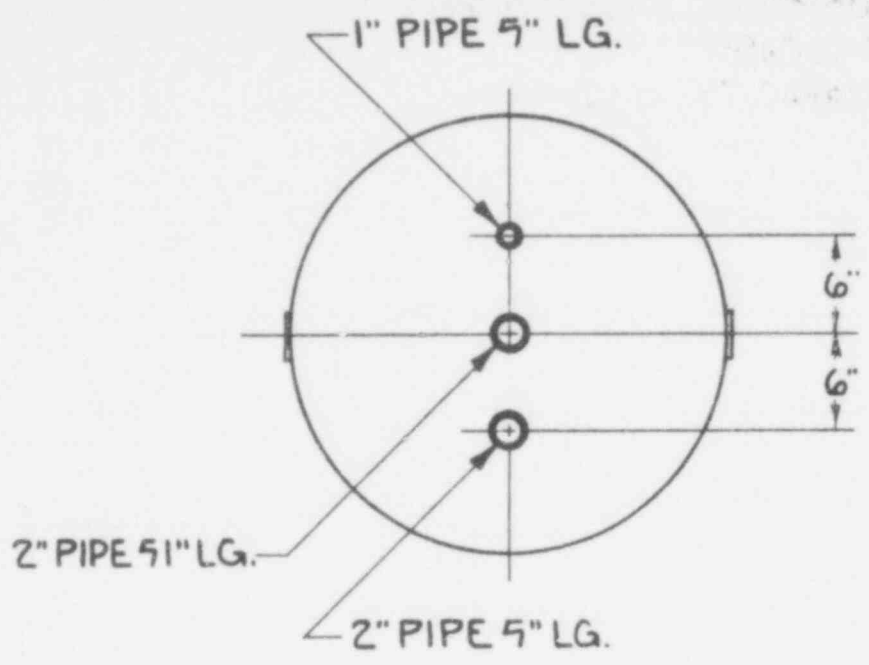
SHEET

DISPOSABLE CONTAINER  
I-13 CASK  
CAPACITY 13 CU. FT.

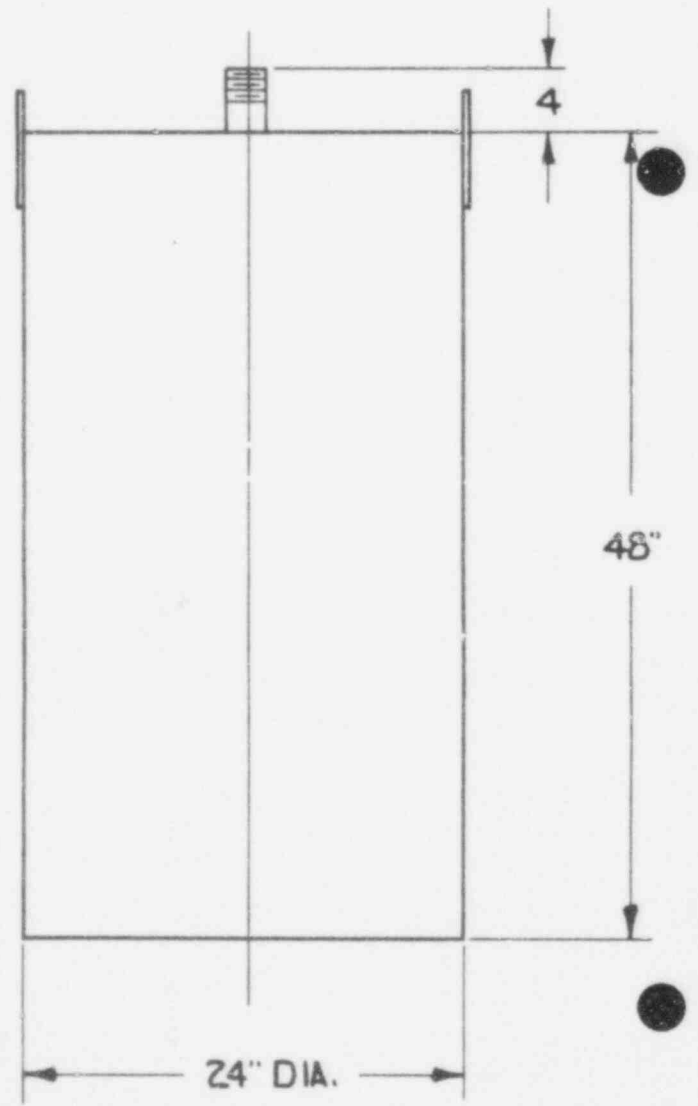
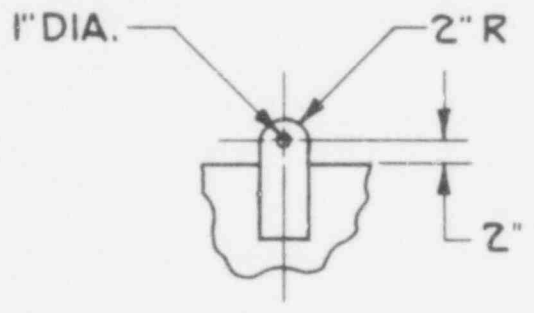


701 161

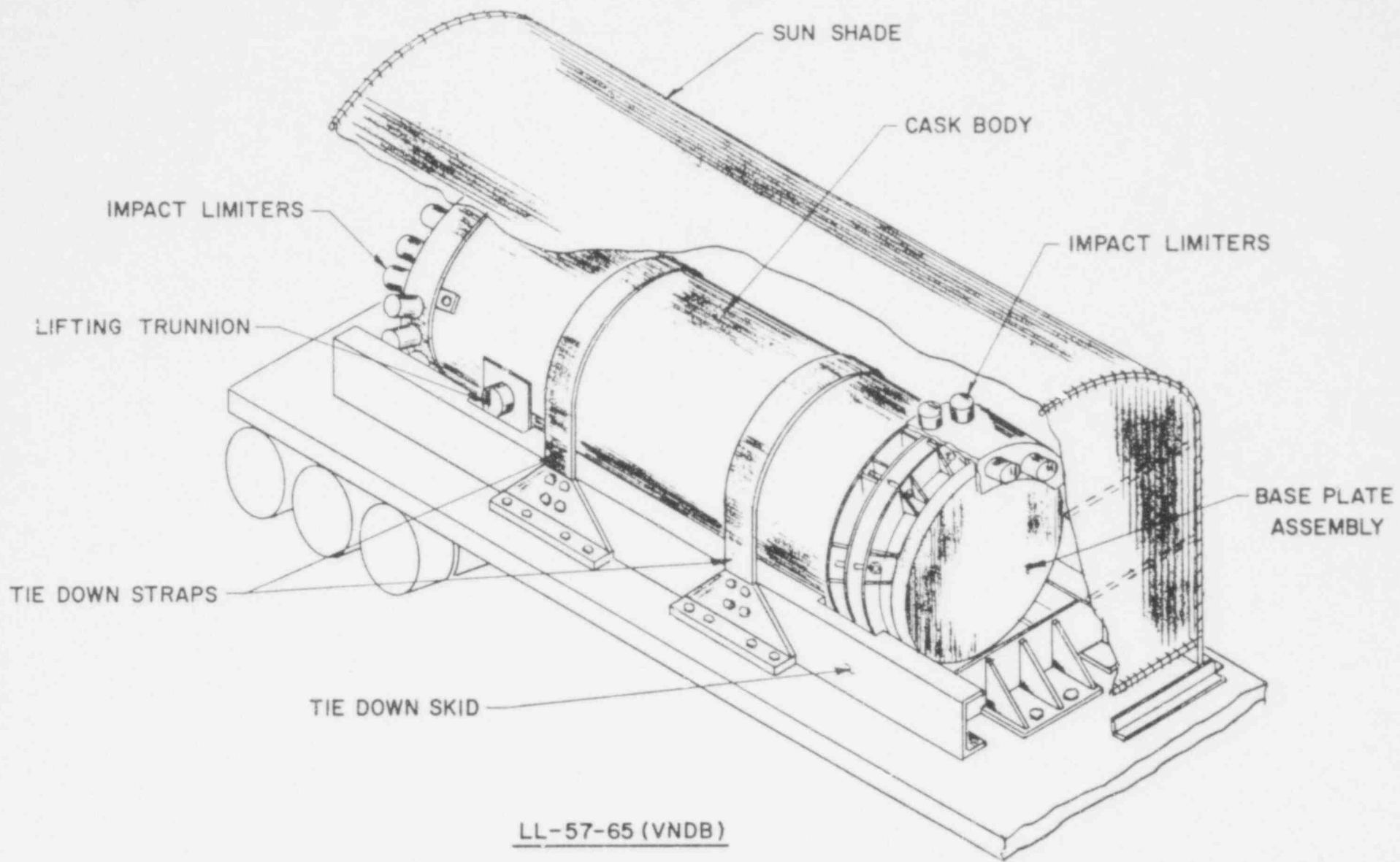
DISPOSABLE CONTAINER  
I-13 CASK  
CAPACITY 13 CU. FT.



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LL-57-65 (VNDB)

(CNS 3-55)

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Rev. 1

CHEM-NUCLEAR SYSTEMS, INC.

TRANSPORT CASK (VNDB)

ATCOR LL-57-65 (CNS 3-55)

SHIELDING: 7.0 IN. LEAD EQUIV.

TYPE B - USA/5805/B( )F

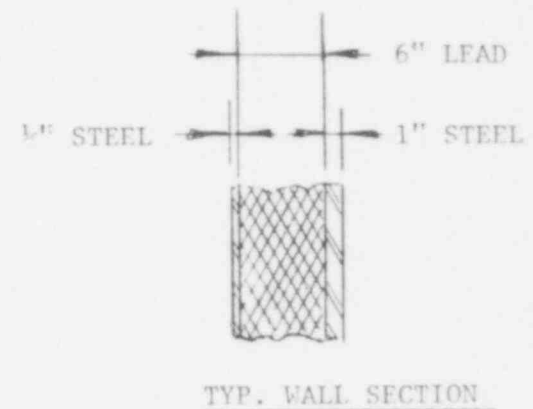
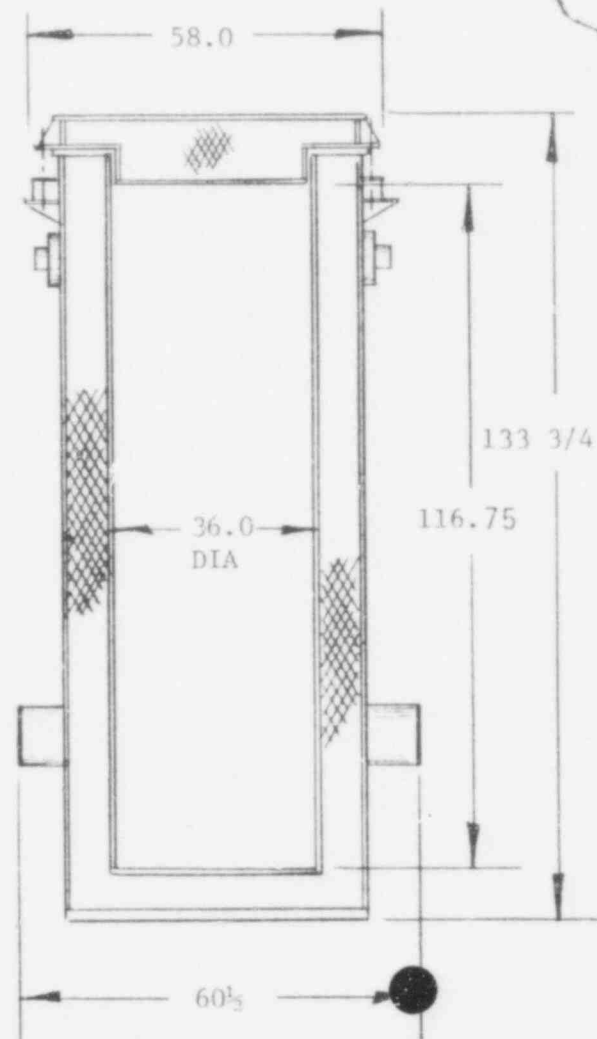
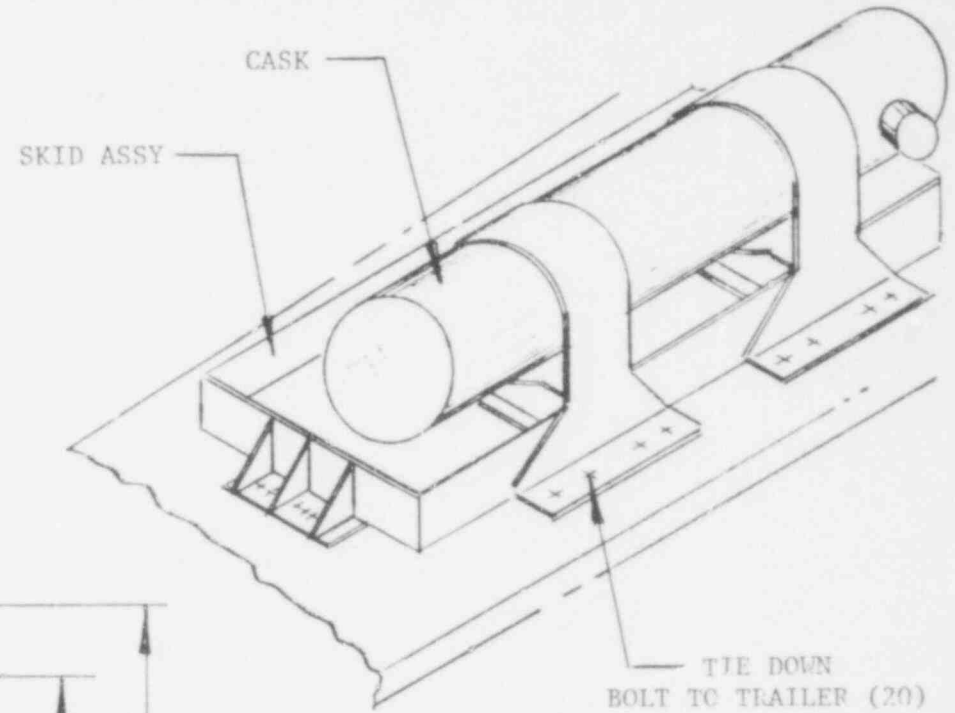
CAPACITY: (3) 55 GAL. DRUMS OR

(1) 60 CU. FT. CONTAINER

WEIGHT: GROSS WT. (EMPTY)

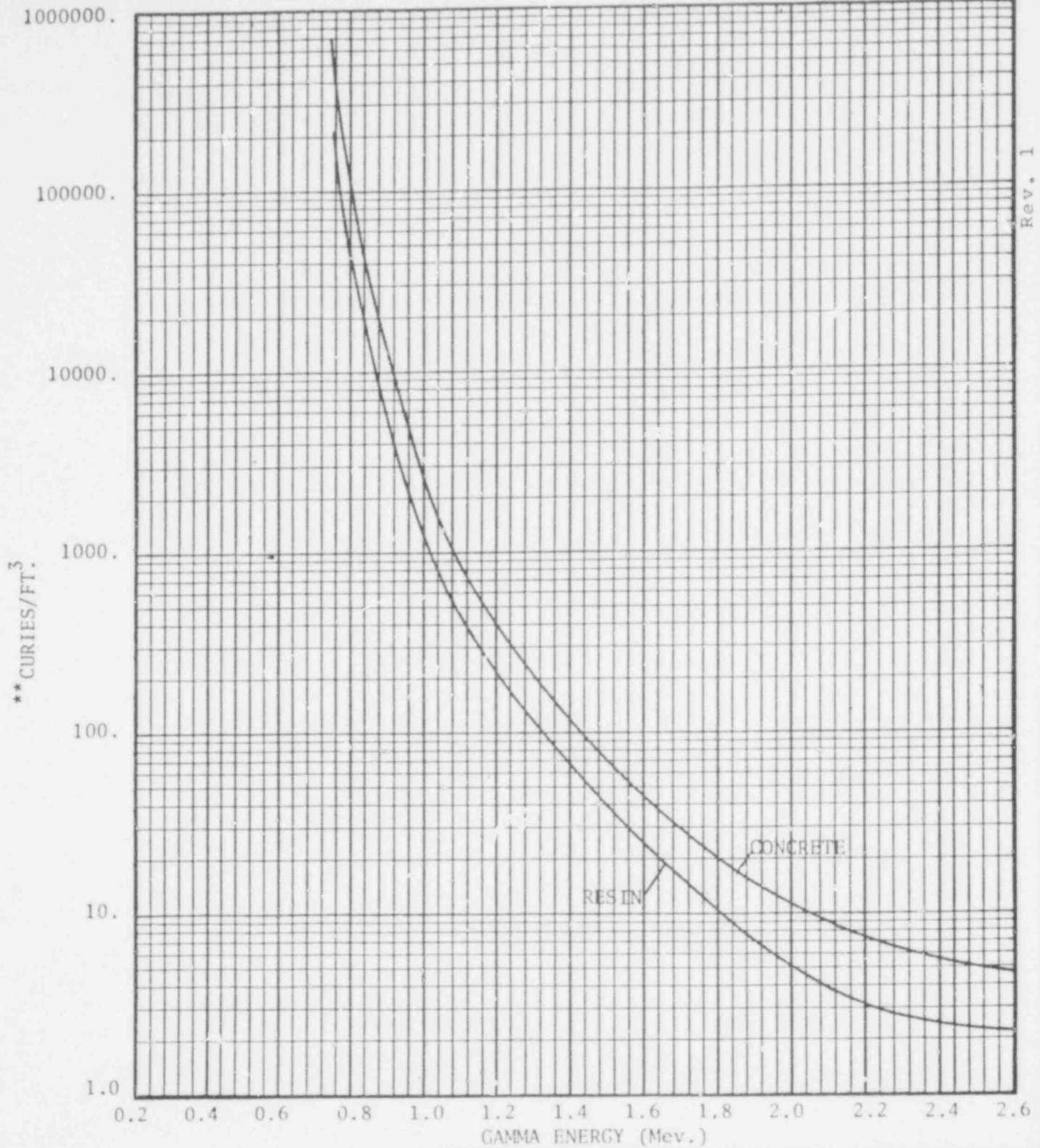
57,000 LBS.

CASK LID 4,500 LBS.



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\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK: CNS 3-55  
(CASK LL-57-65) 1/4 INCH STEEL, 6 INCHES LEAD  
1/4 INCH STEEL

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DATE

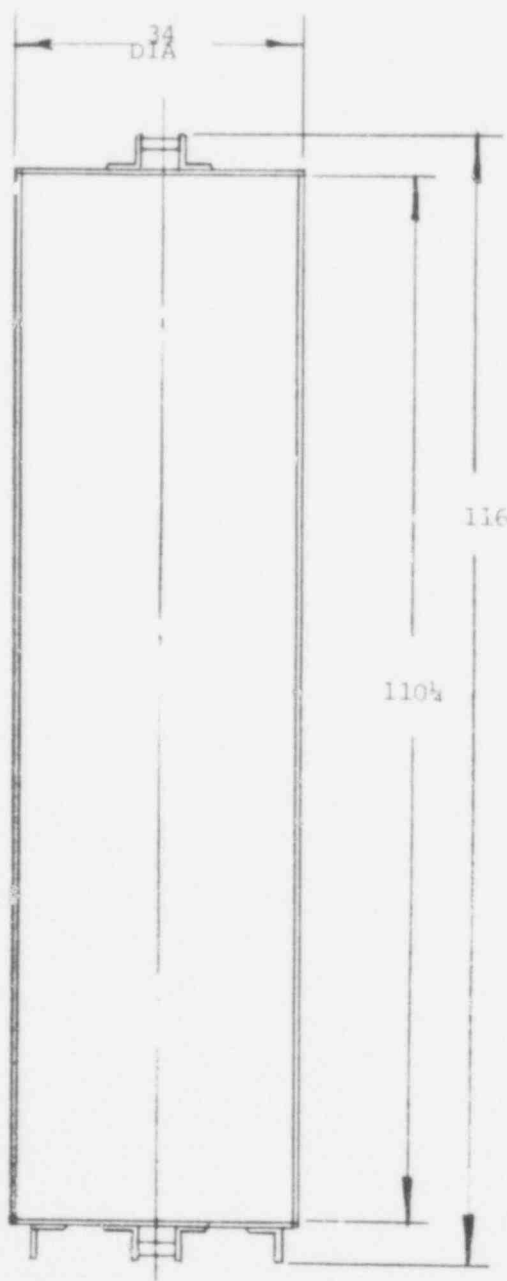
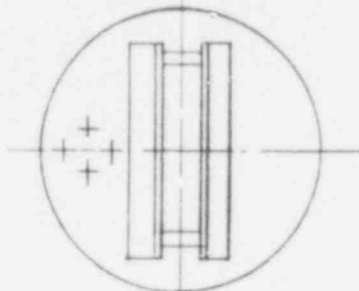
SHEET

CHEM-NUCLEAR SYSTEMS, INC.

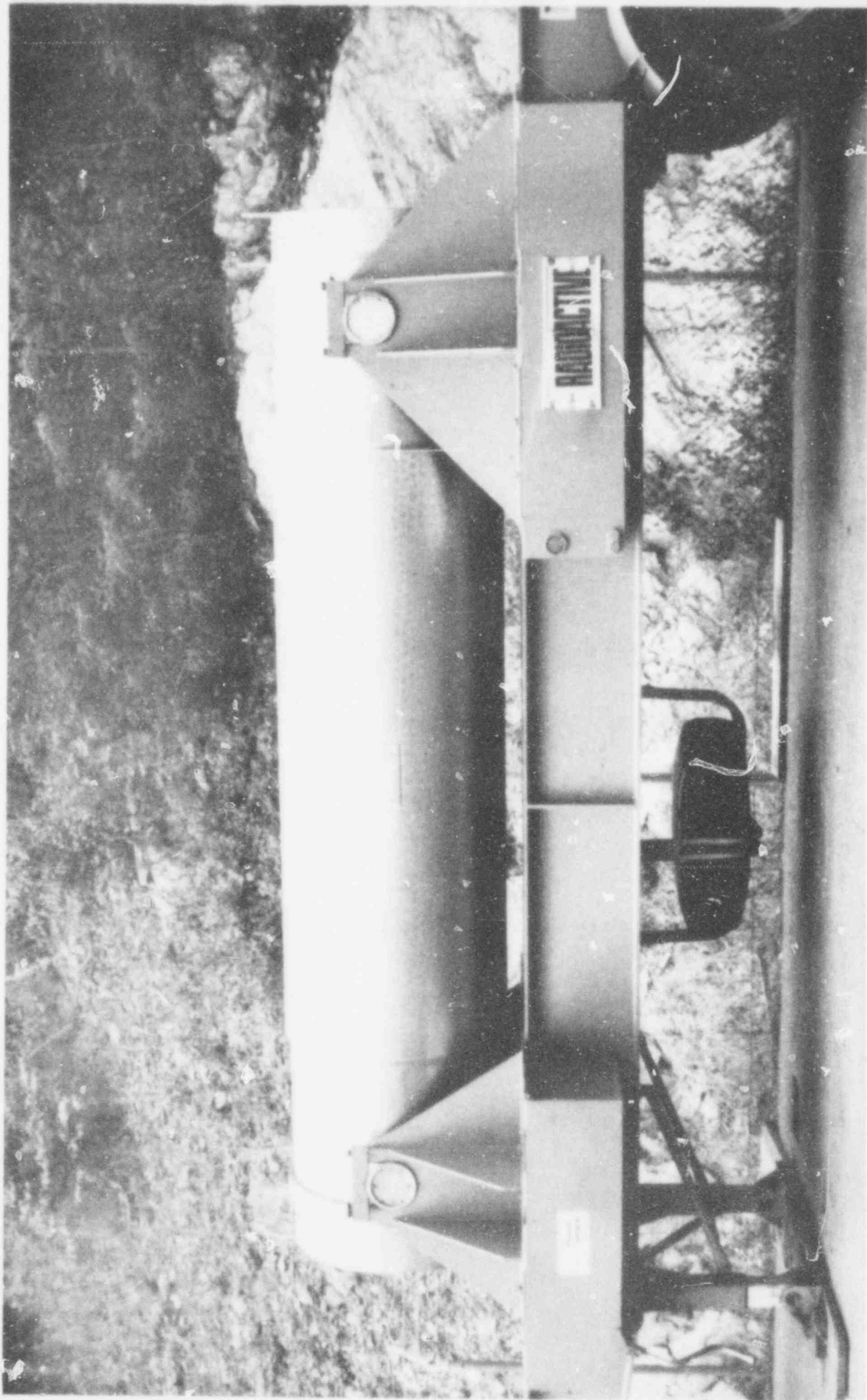
LINER-DISPOSABLE

USED ON CASK LL-57-65 (CNS 3-55)

CAPACITY: 60 CU. FT.



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CHEM-NUCLEAR SYSTEMS, INC.  
CNS 4-45

**POOR ORIGINAL**

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Rev. 1

**CHEM-NUCLEAR SYSTEMS, INC.**

C.N.S. 4-45  
SHIELDING: 6.5 IN.- 7.5 IN. LEAD EQUIV.  
U.S.N.R.C. PACKAGE IDENT NO. U.S.A./6375/BI ) F

CAPACITY

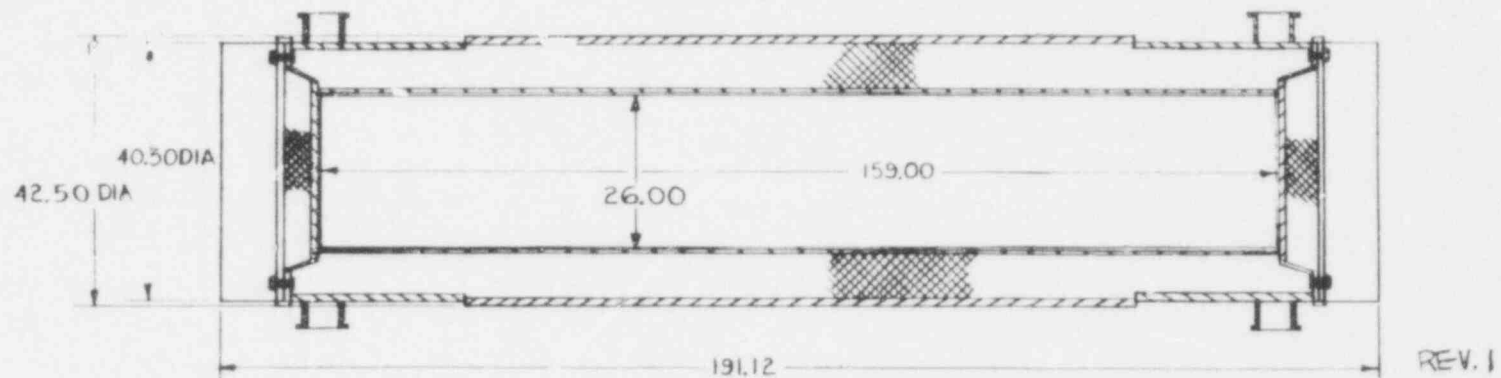
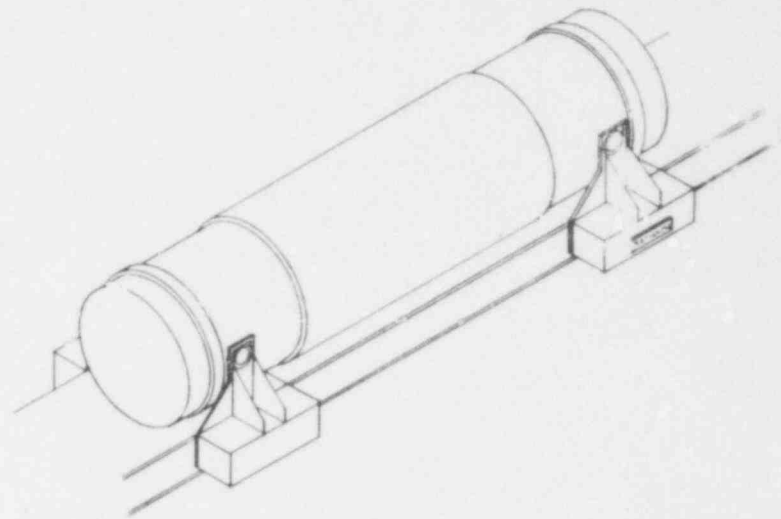
(4) 55 GAL. DRUMS  
OR (1) 45 CU. FT. CONTAINER

WEIGHT

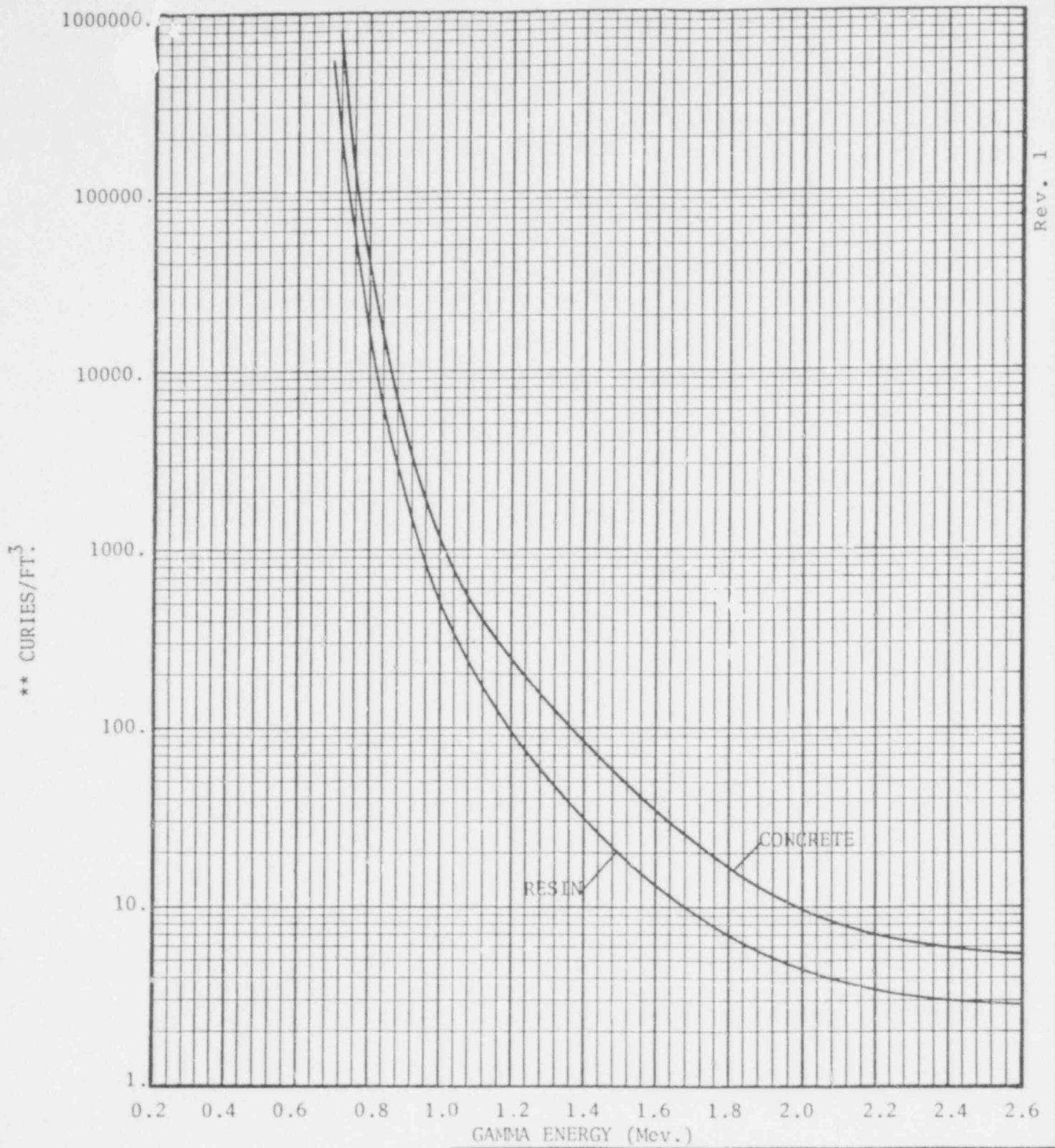
GROSS WEIGHT: 57,050 LBS (EMPTY)  
CASK BODY WEIGHT: 51,800 LBS  
LIDS: 1,995 LBS (EA)  
IMPACT LIMITERS: 630 LBS (EA)

MODE OF TRANSPORTATION

TRUCK/TRAILER



701 168



\*\* CURIES/FT.<sup>3</sup>

GAMMA ENERGY (Mev.)

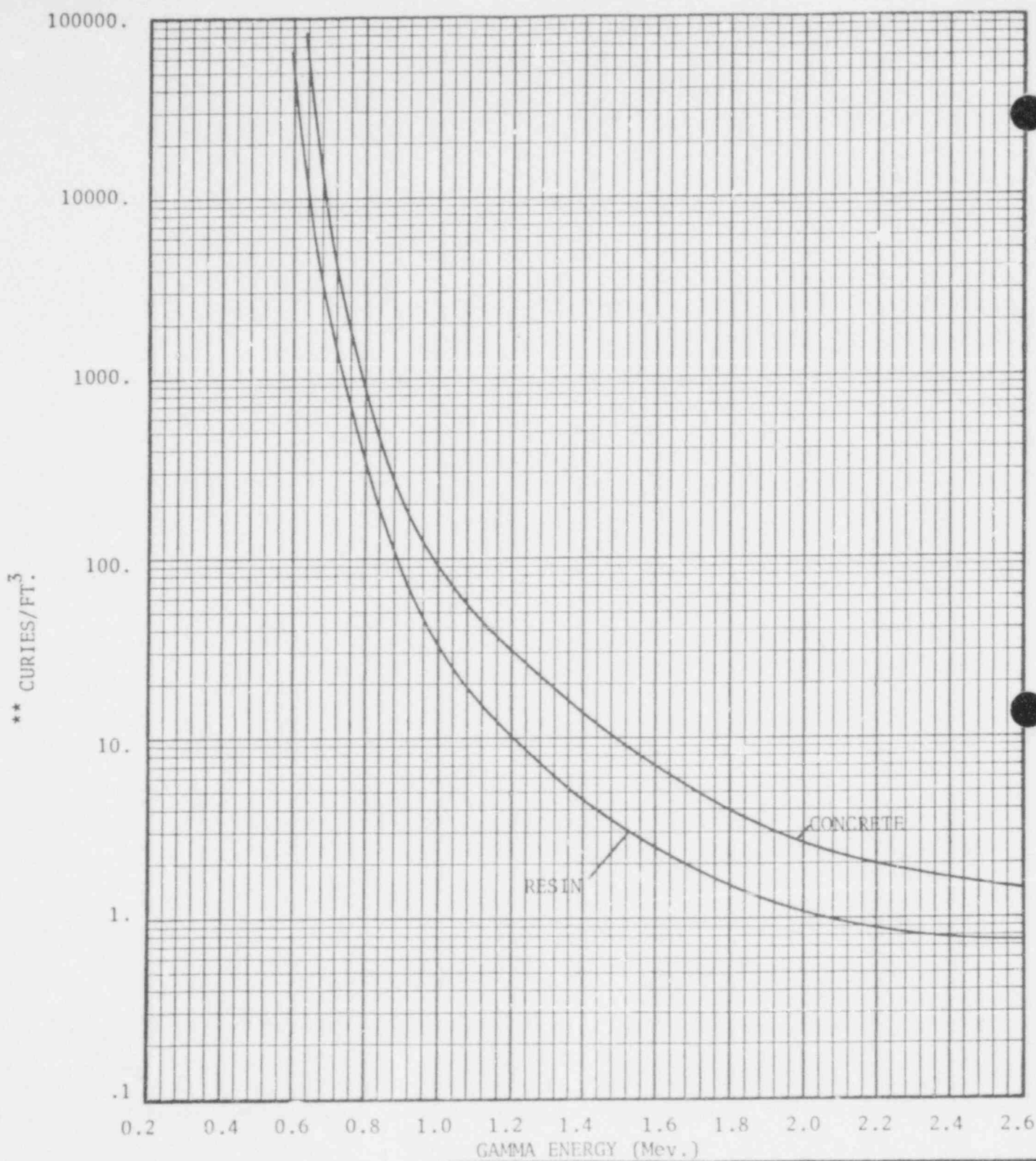
### CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX  
 DOSE RATE AT 6 FEET  
 FROM CASK IS 10 MR/HR

CASK 4-45 1-1/4 INCHES STEEL,  
 6-1/4 INCHES LEAD  
 SHIELDING ON SIDE

701 169

REV.	DATE	SHEET
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\*\* CURIES/FT.<sup>3</sup>

GAMMA ENERGY (Mev.)

### CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

CASK 4-45 3/4 INCH STEEL, 4 INCHES LEAD,  
3/4 INCH STEEL  
SHIELDING ON TOP

701 170

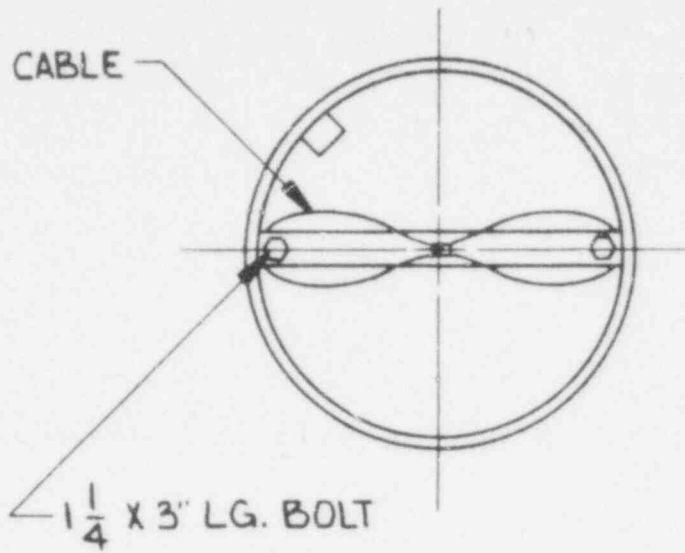
REV.

DATE

SHEET



DISPOSABLE CONTAINER  
4-45 CASK  
CAPACITY 45 CU. FT.

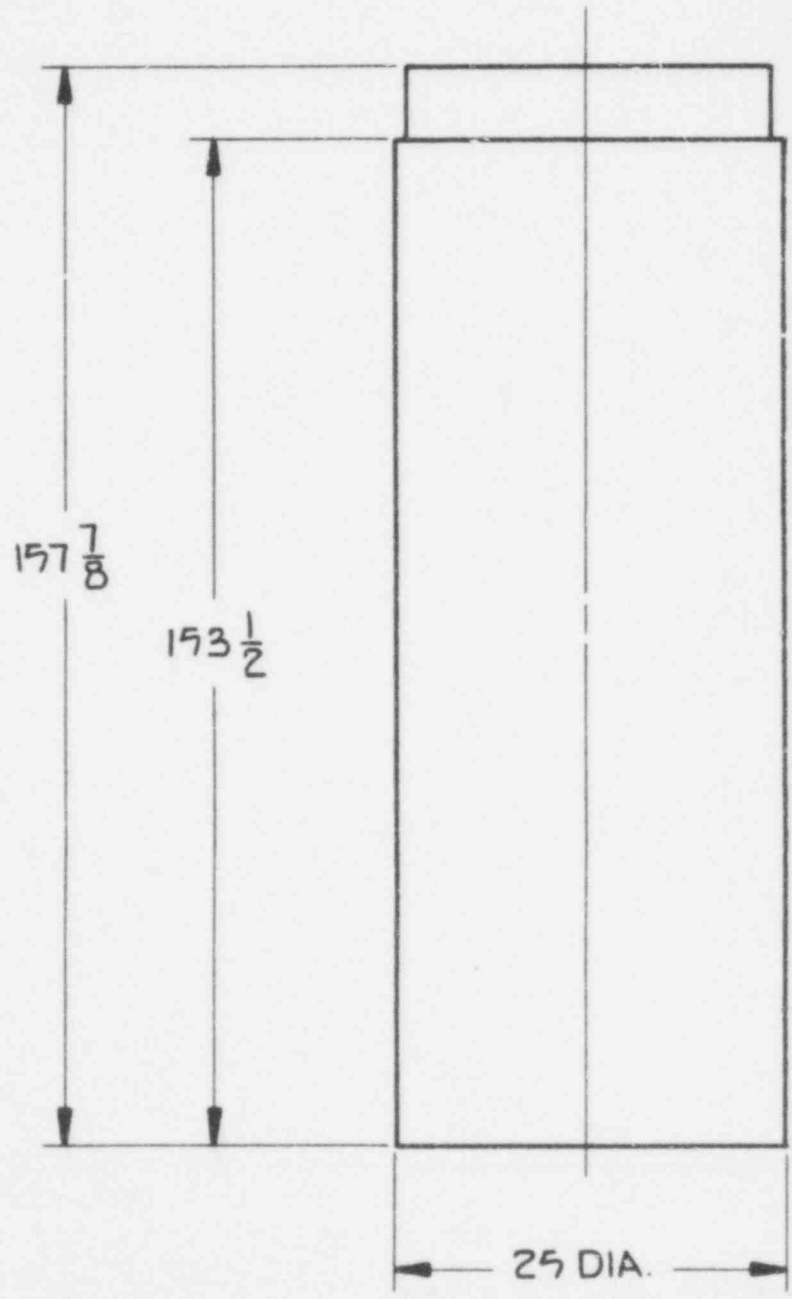
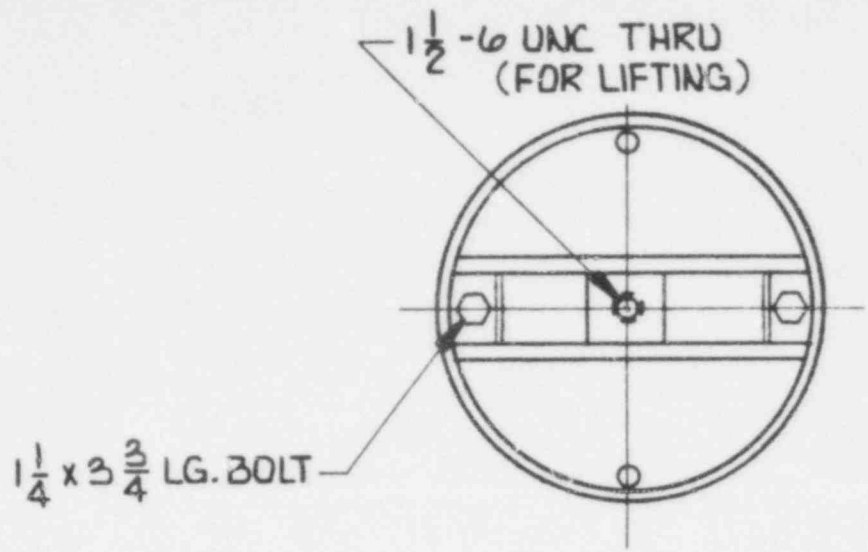


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DISPOSABLE CONTAINER  
4-45 CASK  
CAPACITY 45 CU. FT.

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701 172



**POOR ORIGINAL** 701 173

CHEM-NUCLEAR SYSTEMS, INC.  
CNS 4-85

**CHEM-NUCLEAR SYSTEMS, INC.**

CNS 4-85 (6244)

SHIELDING: 4.38 IN. LEAD EQUIV

USNRC PACKAGE IDENT. NO. USA/6244/B ( 1 )

CAPACITY

(4) 55 GAL DRUMS OR (1) 88 CU FT CONTAINER

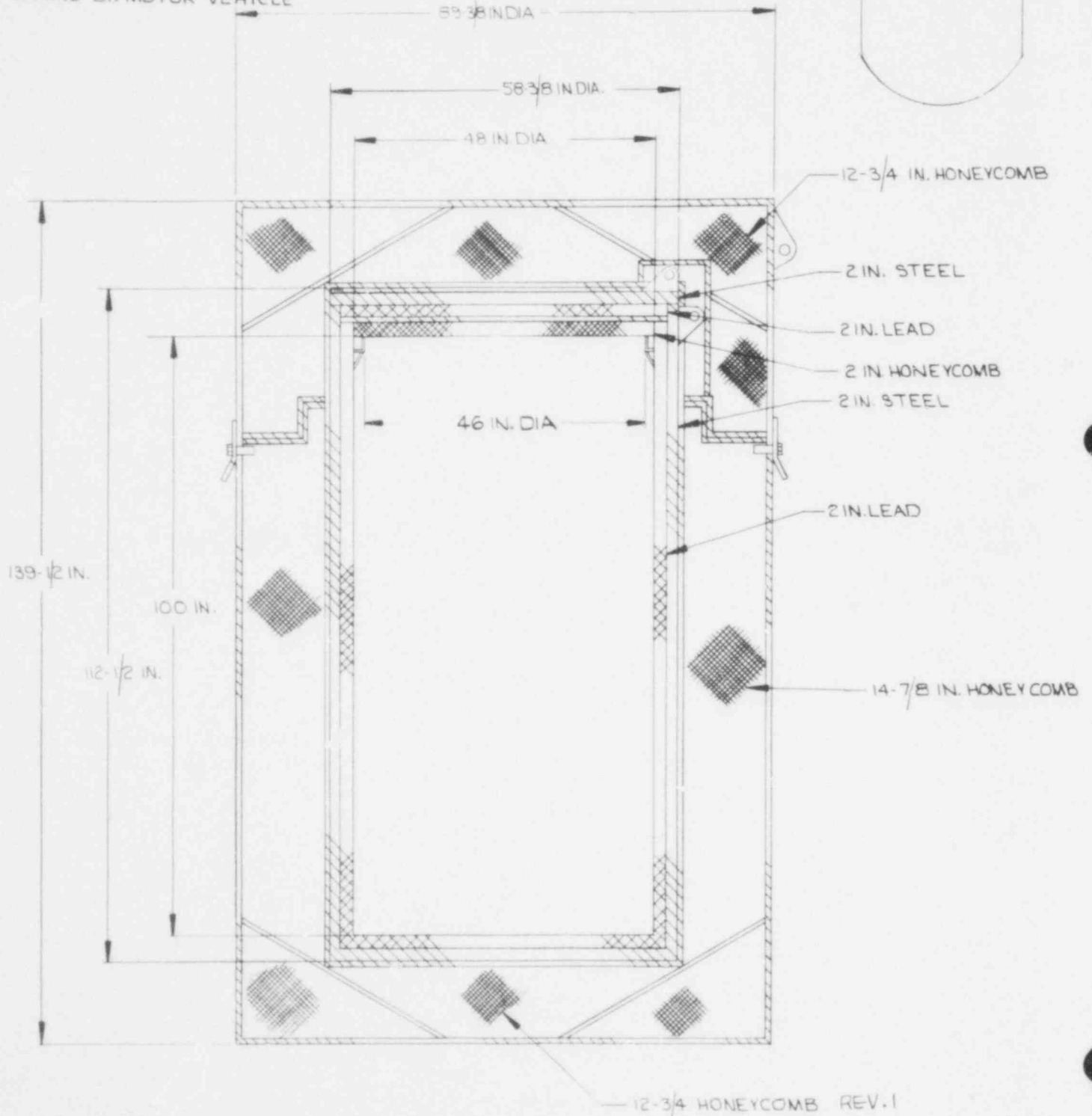
WEIGHT 40,300

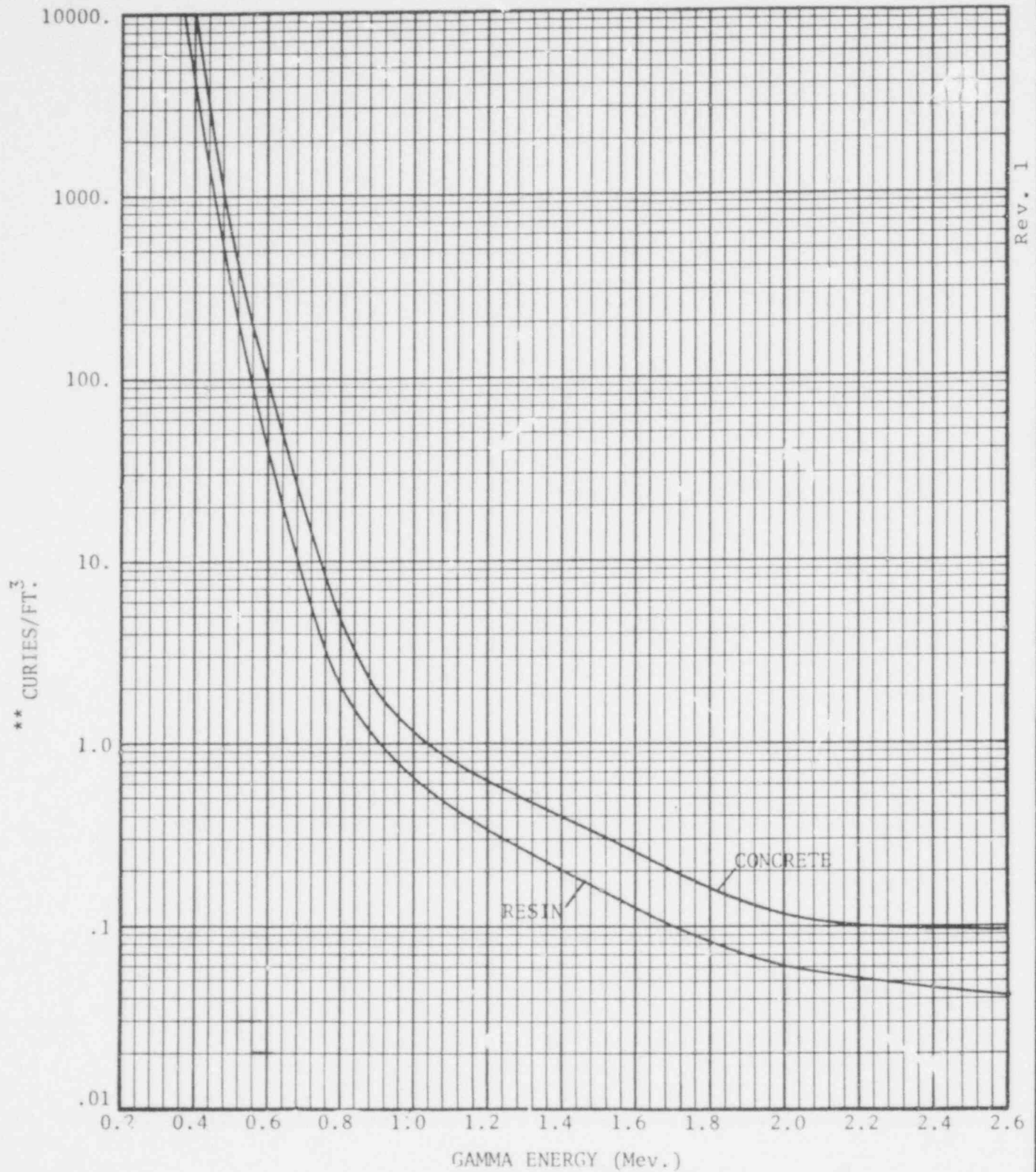
GROSS WEIGHT: ~~42,000~~ LBS. (EMPTY)

CASK LID 3500 LBS.

MODE OF TRANSPORTATION

MARINE OR MOTOR VEHICLE





Rev. 1

\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

## CHEM-NUCLEAR SYSTEMS, INC.

CASK 4-85 2 INCHES STEEL, 2 INCHES LEAD

701 175

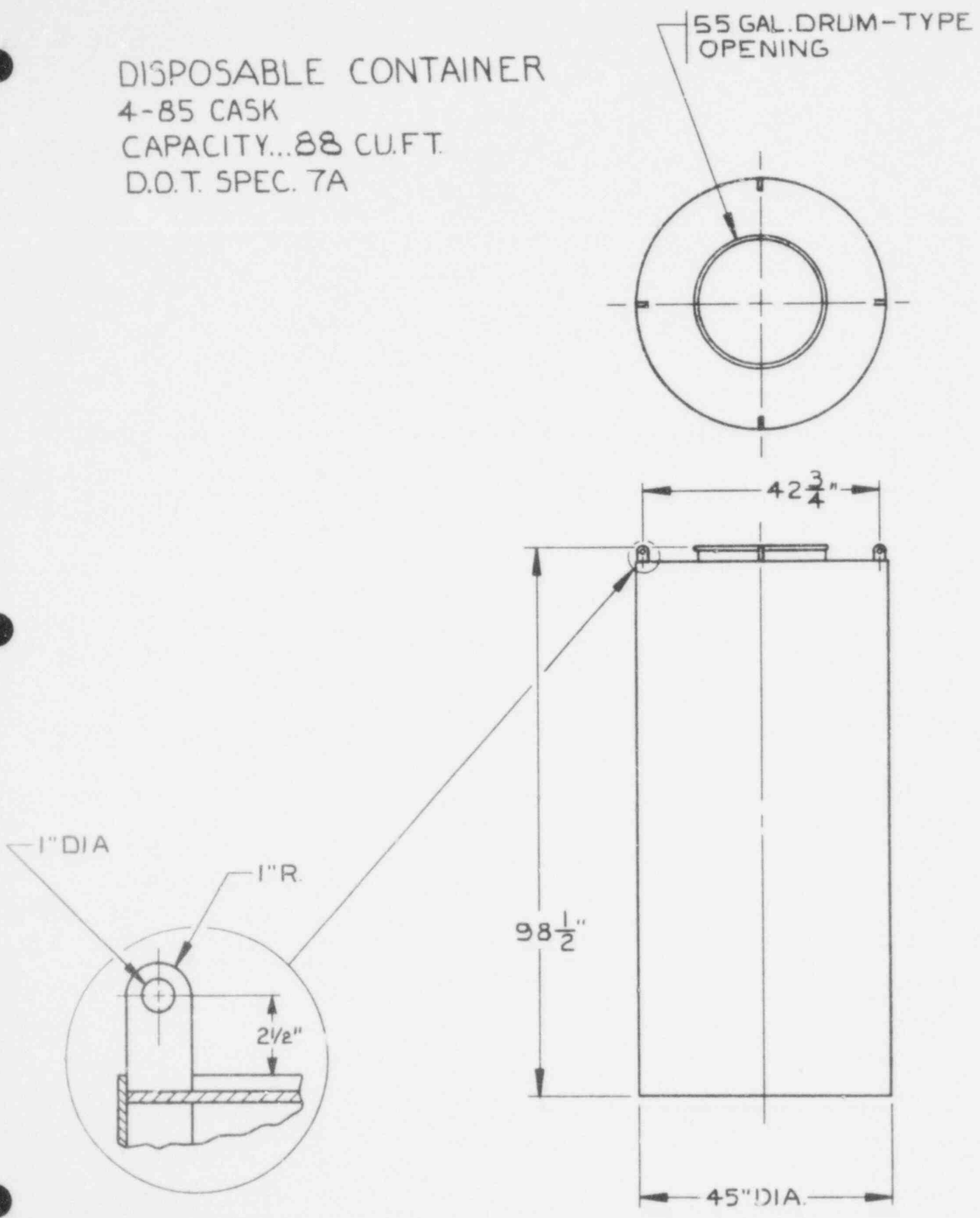
REV.

DATE

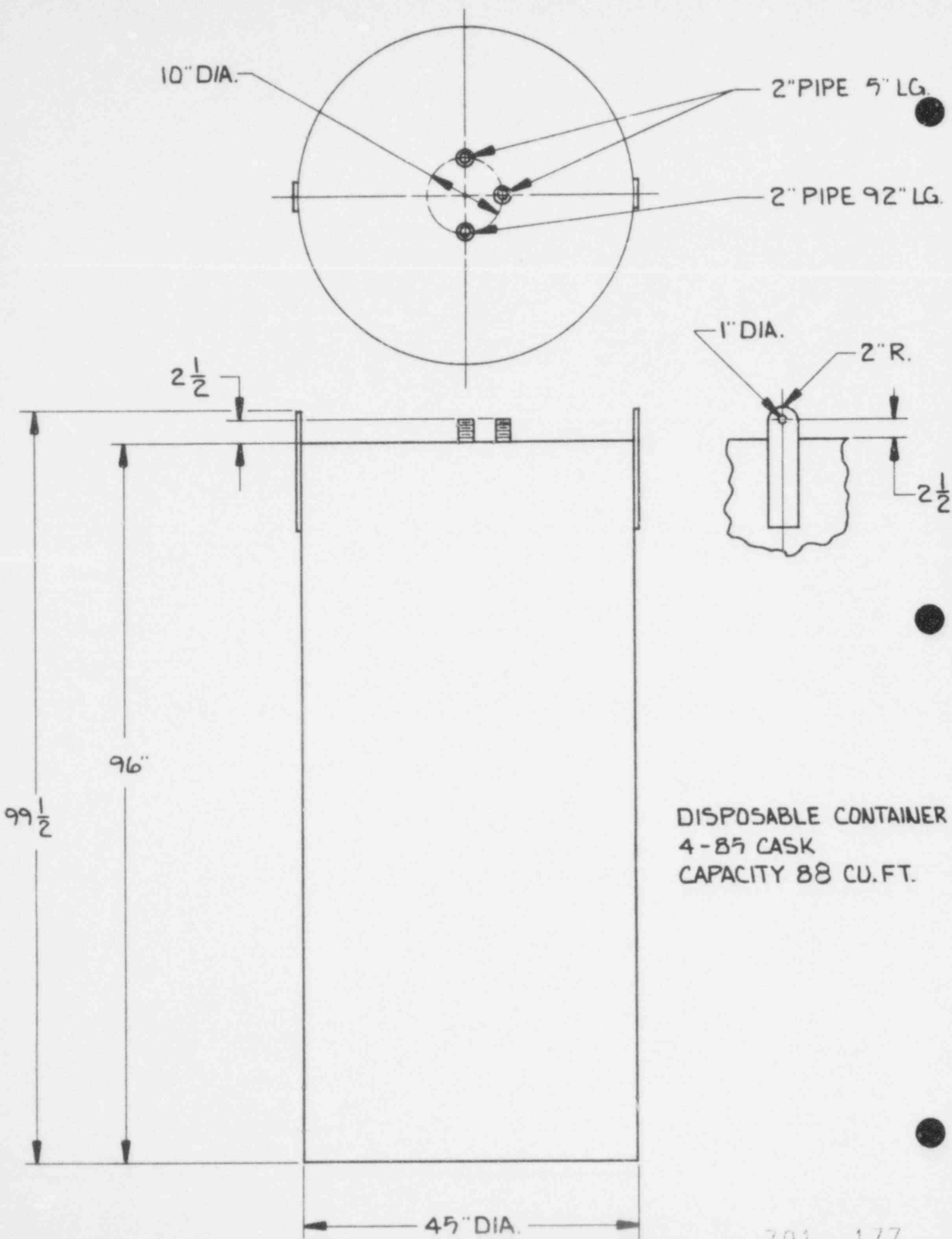
SHEET

DISPOSABLE CONTAINER  
4-85 CASK  
CAPACITY...88 CU.FT.  
D.O.T. SPEC. 7A

REV. 1



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10" DIA.

2" PIPE 5" LG.

2" PIPE 92" LG.

2 1/2

1" DIA.

2" R.

2 1/2

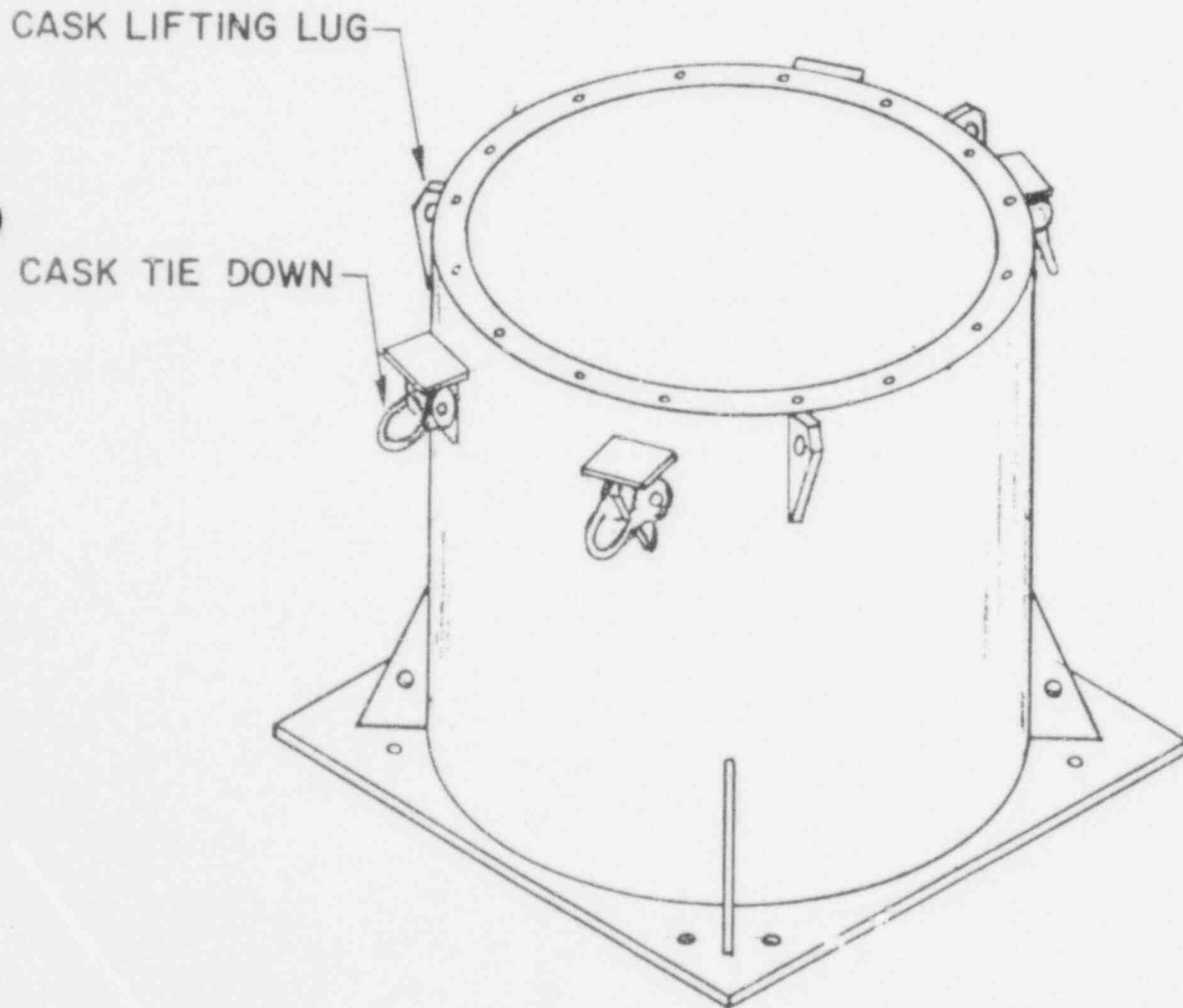
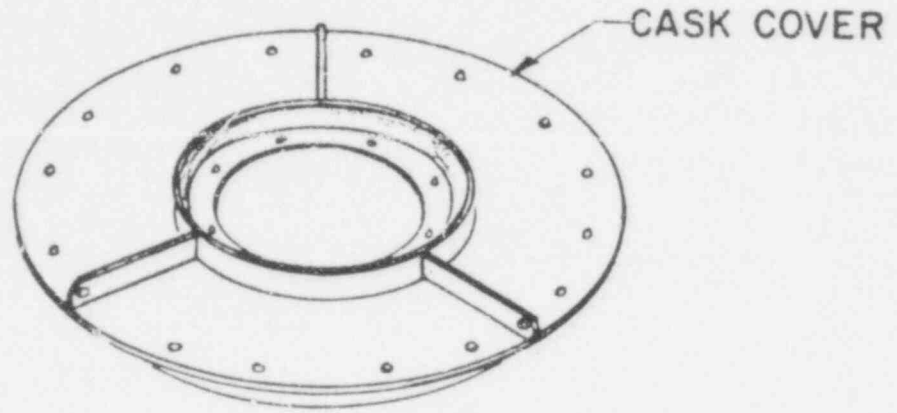
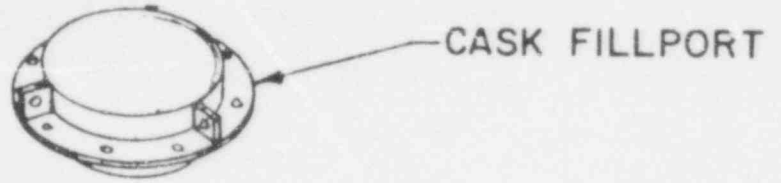
99 1/2

96"

45" DIA.

DISPOSABLE CONTAINER  
4-85 CASK  
CAPACITY 88 CU. FT.

701 177



**AL-33-90**

(CNS 6-75)

701 178



TRANSPORT CASK

ATCOR AL-33-90 (CNS 6-75)

SHIELDING: 4.0 IN. LEAD EQUIV.

TYPE A - USA/9108/A

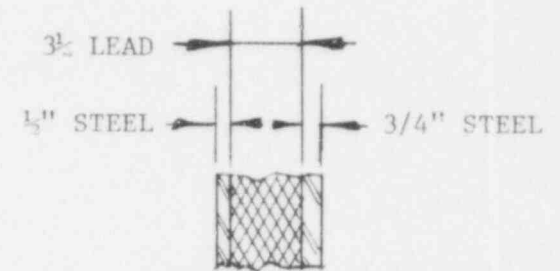
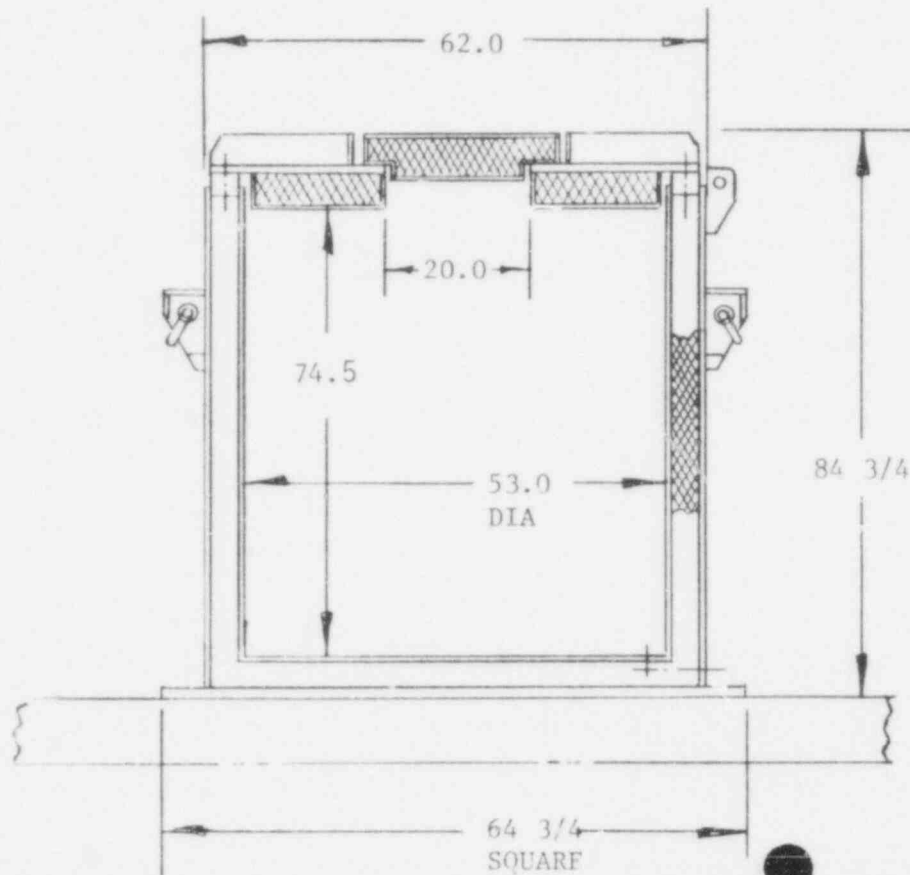
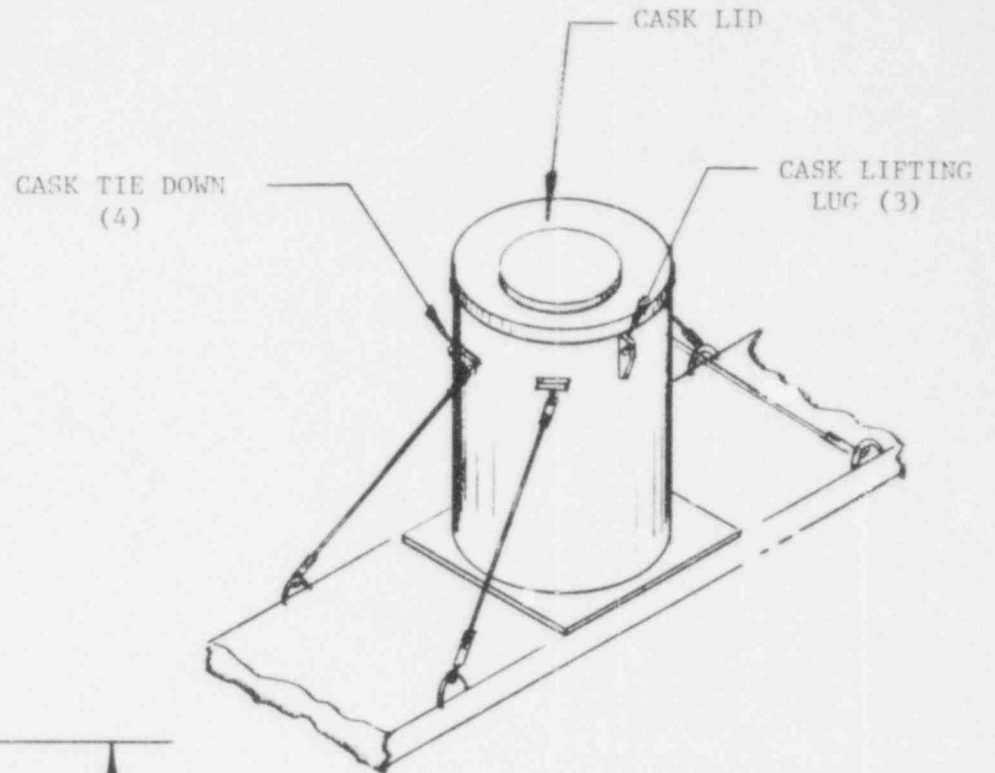
CAPACITY: (6) 55 GAL. DRUMS OR

(1) 85 CU. FT. CONTAINER

WEIGHT: GROSS WT. (EMPTY)

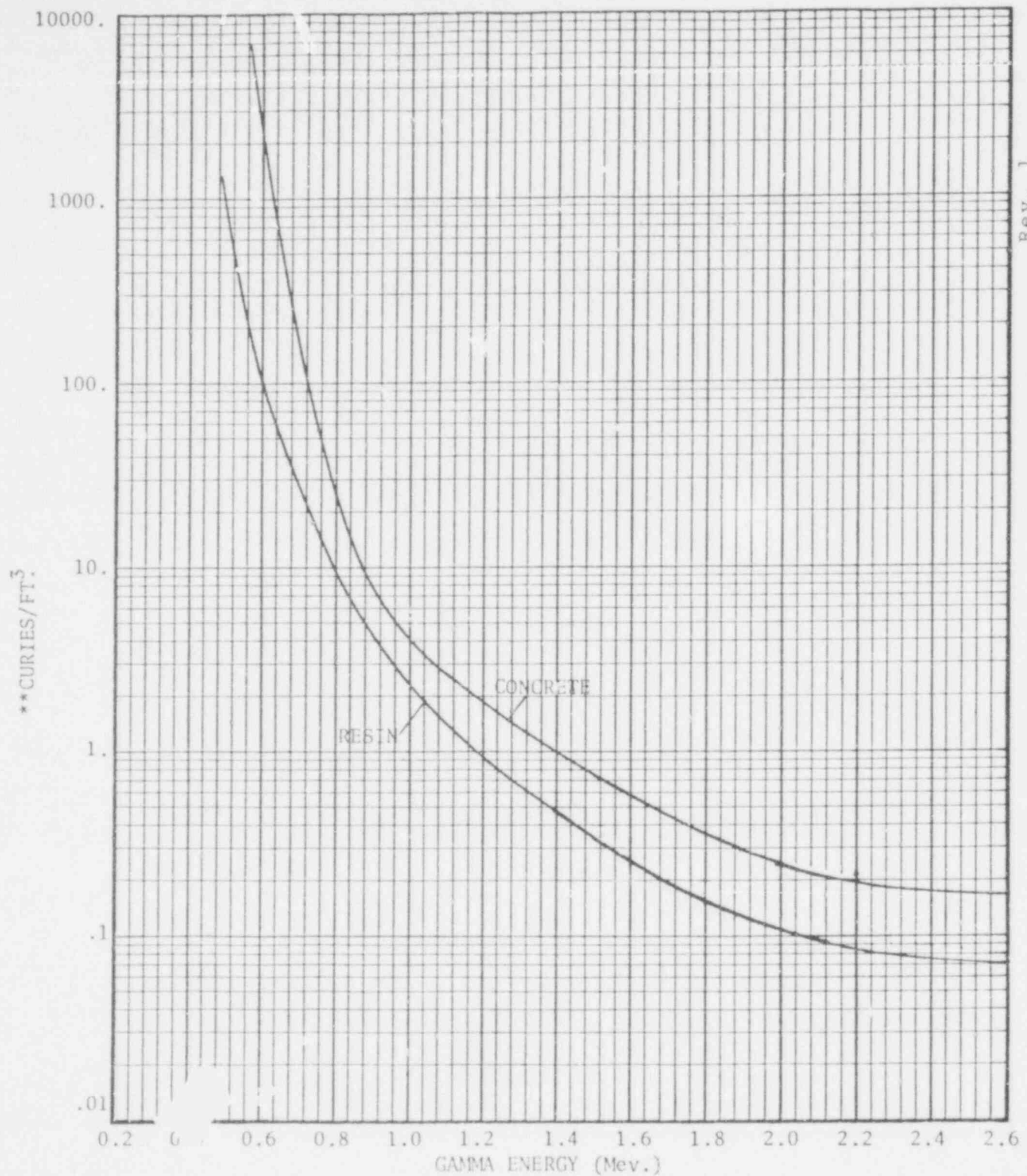
31,000 LBS.

CASK LID 3,800 LBS.



TYP. WALL SECTION

701 179



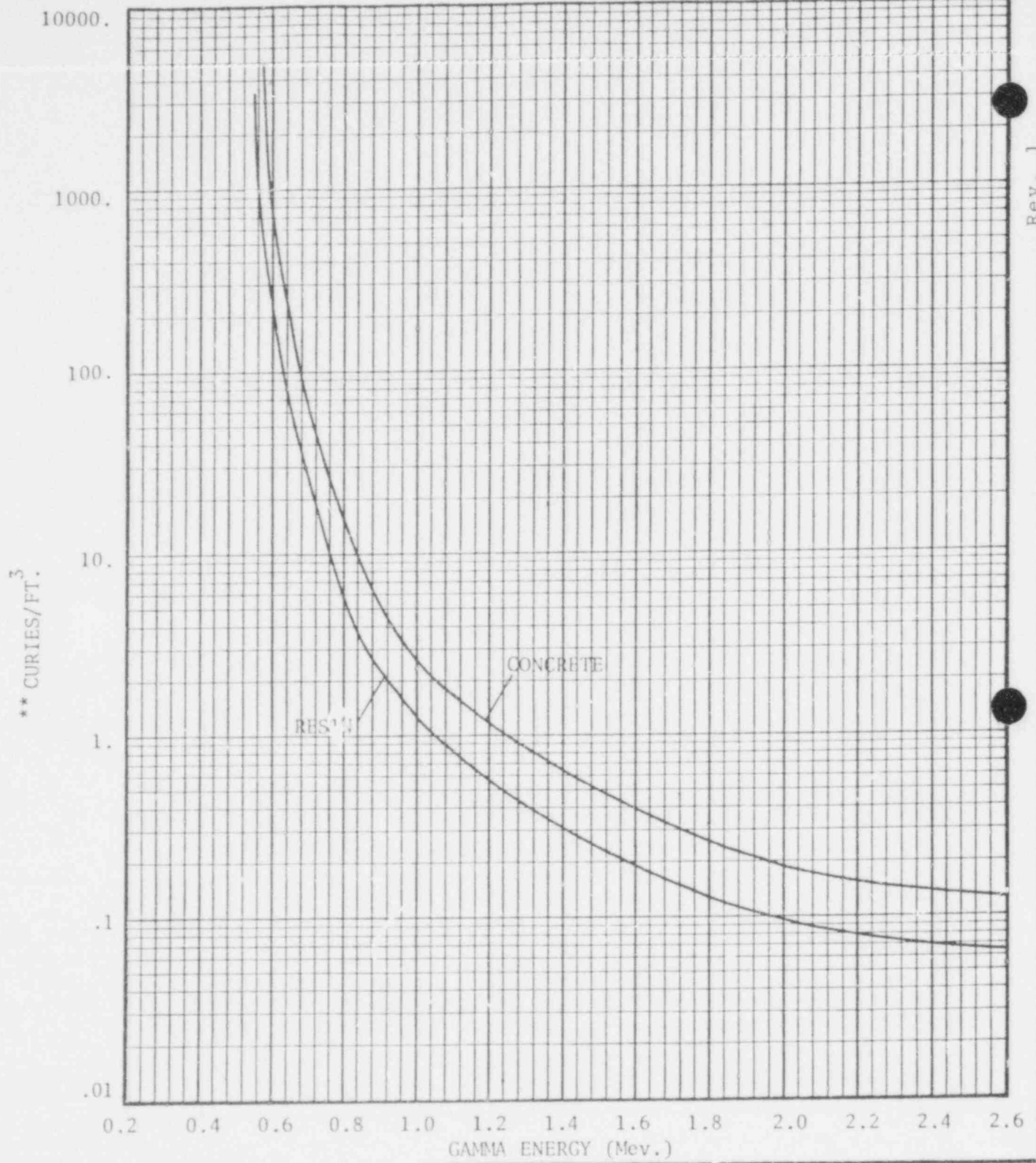
\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK: CNS 6-75  
 (CASK AL-33-90) 3/4 INCH STEEL,  
 3-1/4 INCHES LEAD,  
 1/2 INCH STEEL  
 SHIELDING ON SIDE

REV.	DATE	SHEET



\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK: CNS 6-75  
(CASK AL-33-90) 1 INCH STEEL, 2.87 INCHES LEAD,  
1/2 INCH STEEL  
SHIELDING ON TOP

701 181

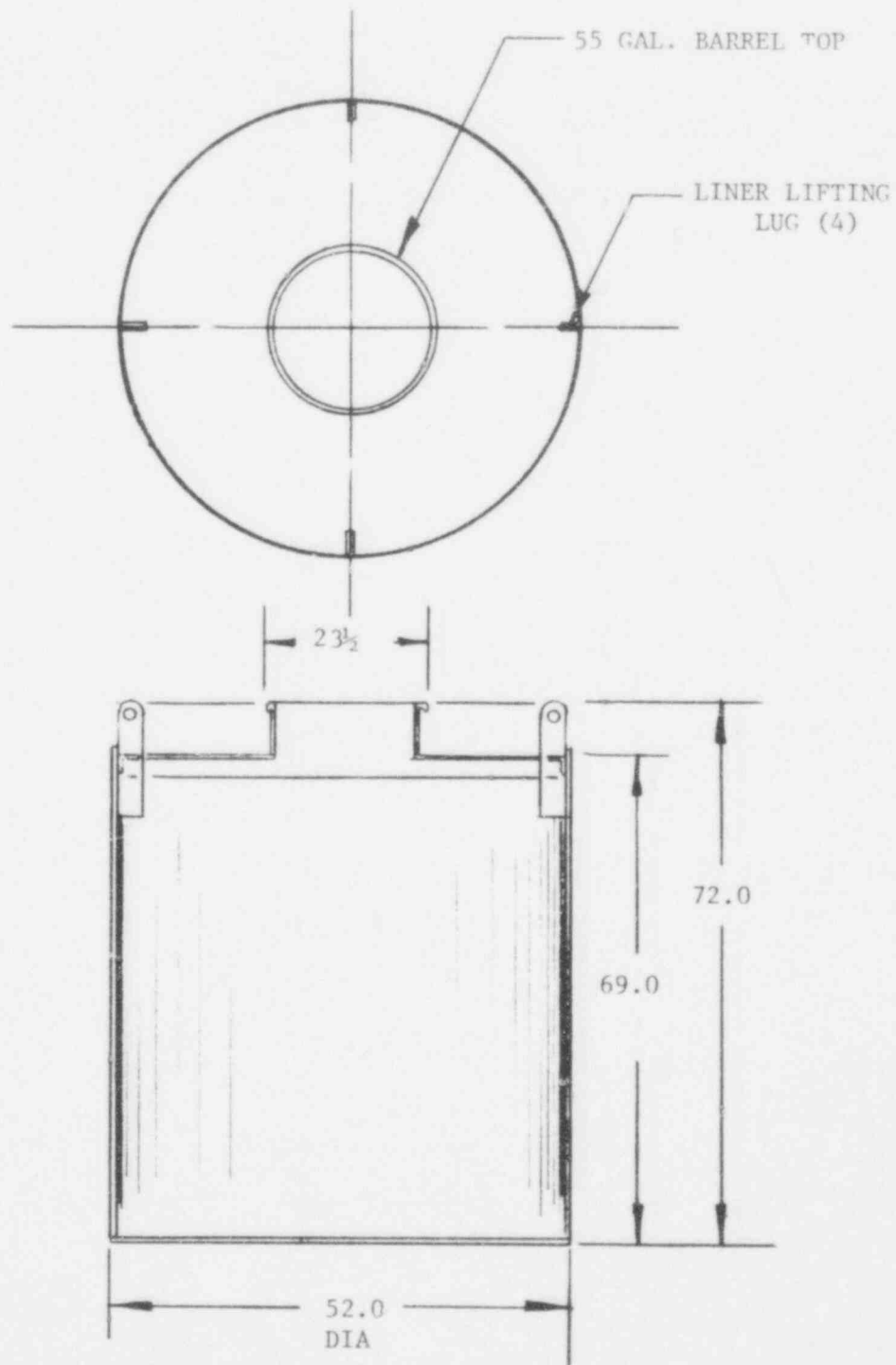
REV.

DATE

SHEET

CHEM-NUCLEAR SYSTEMS, INC.

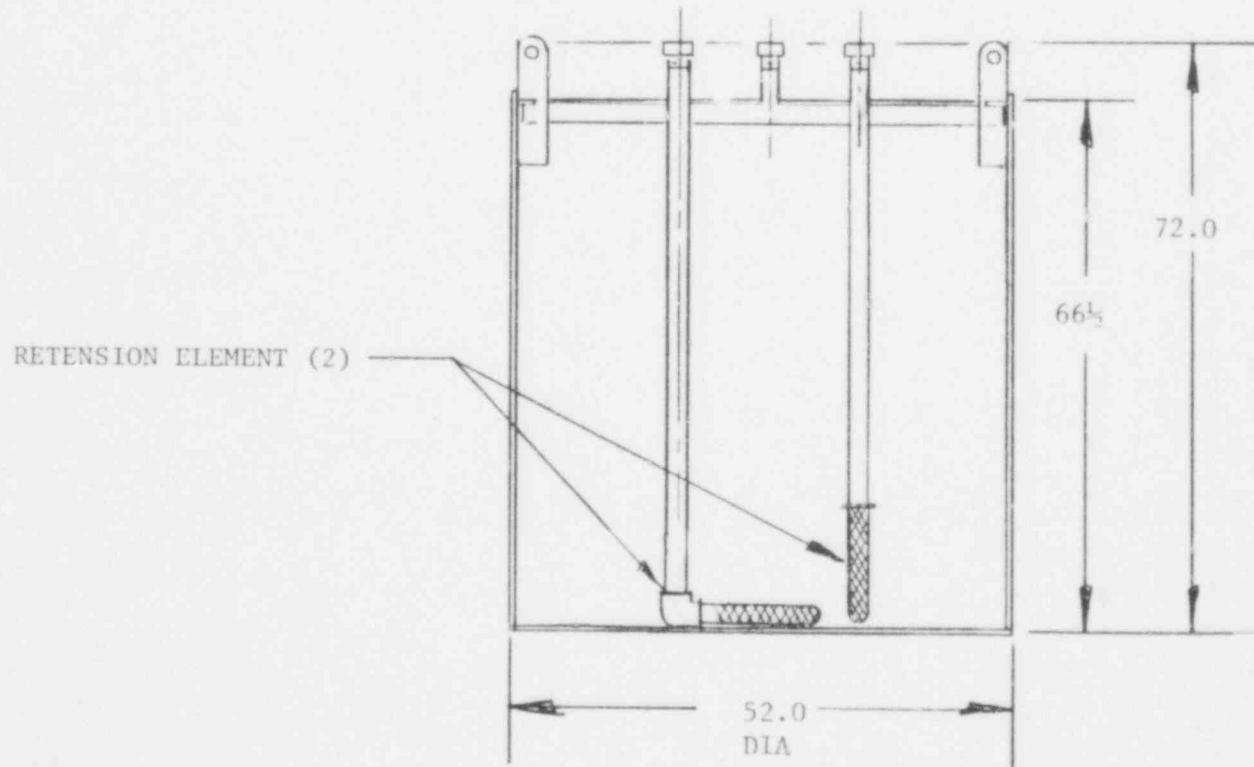
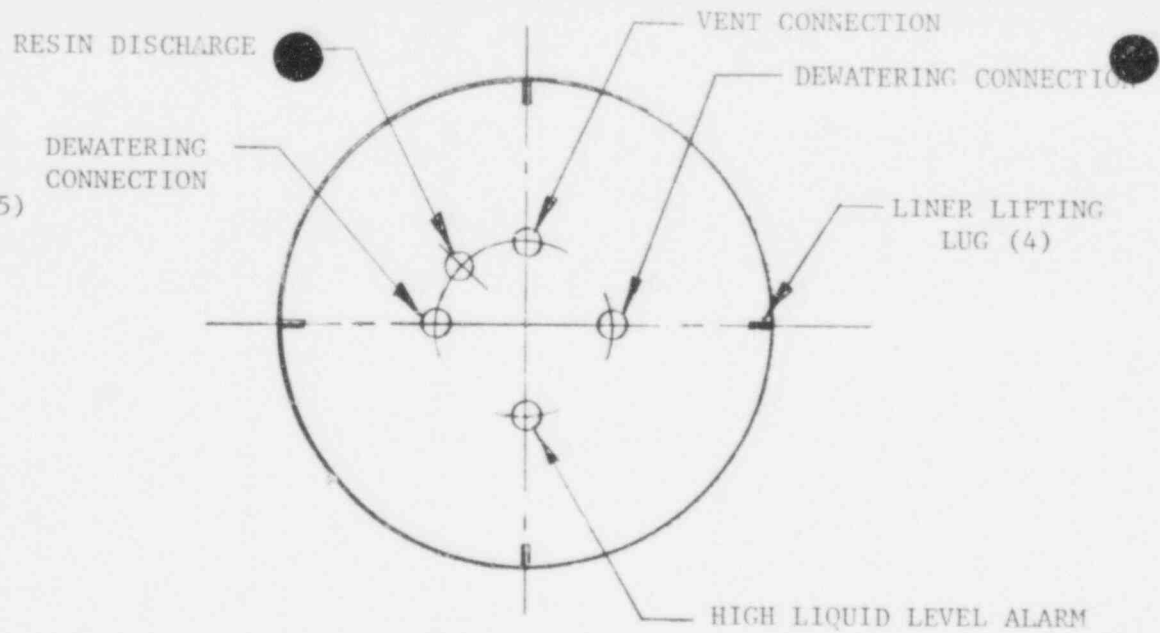
LINER-SOLID WASTE  
USED ON AL-33-90 (CNS 6-75)  
CAPACITY 85 CU. FT.



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CHEM-NUCLEAR SYSTEMS, INC.

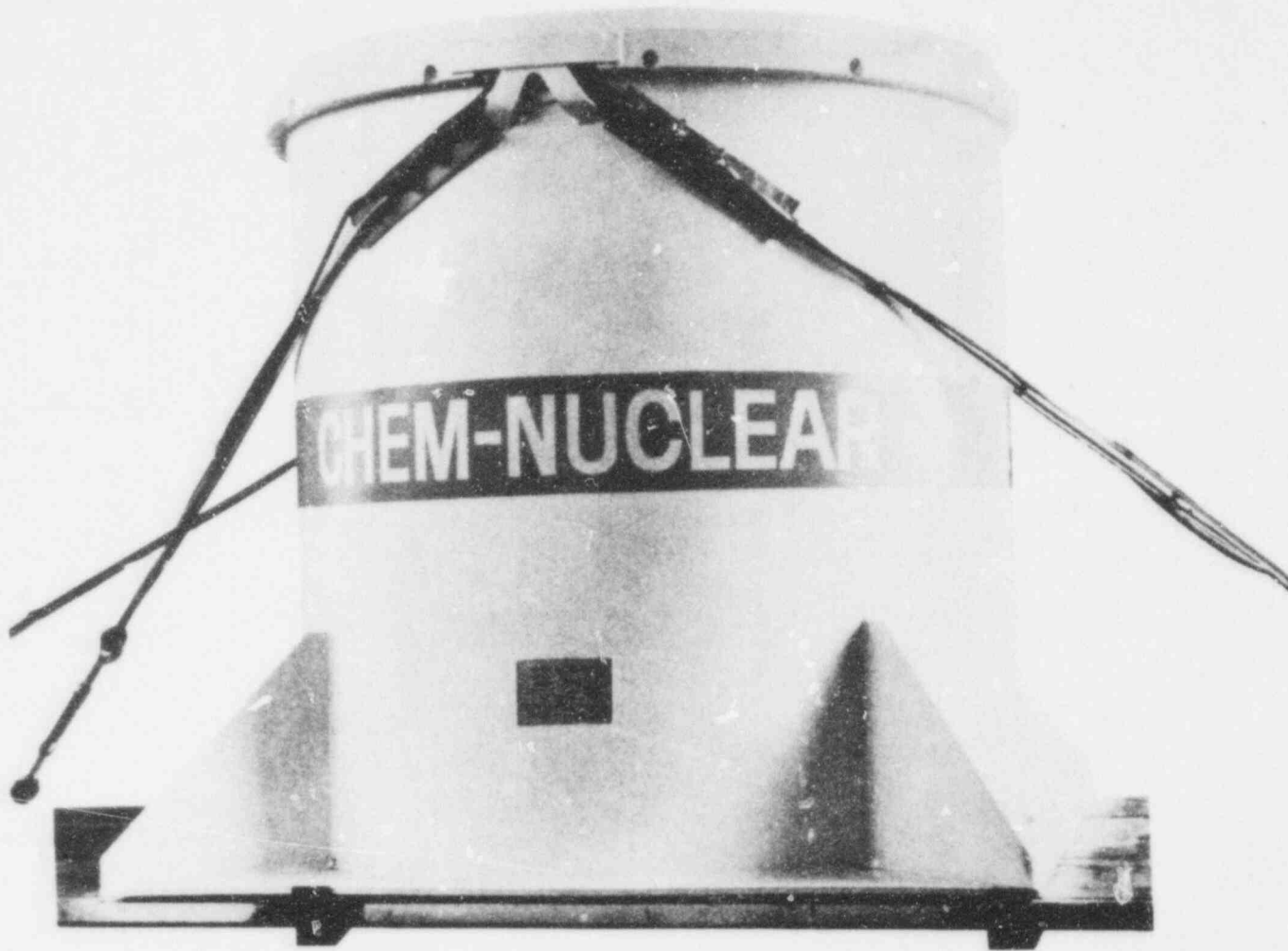
LINER-RESIN  
USED ON CASK AL-33-90 (CNS 6-75)  
CAPACITY 85 CU. FT.



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POOR ORIGINAL

701 184



CHEM-NUCLEAR SYSTEMS, INC.  
CNS 6-80-1

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**CHEM-NUCLEAR SYSTEMS, INC.**

TRANSPORT CASK & LINER

C.N.S. 6-80-1

SHIELDING: TRANSPORT CASK WITH LINER - 5.00 IN. LEAD EQUIV.

CAPACITY

(6) 55 GAL. DRUMS OR

(1) 85 CU. FT. CONTAINER

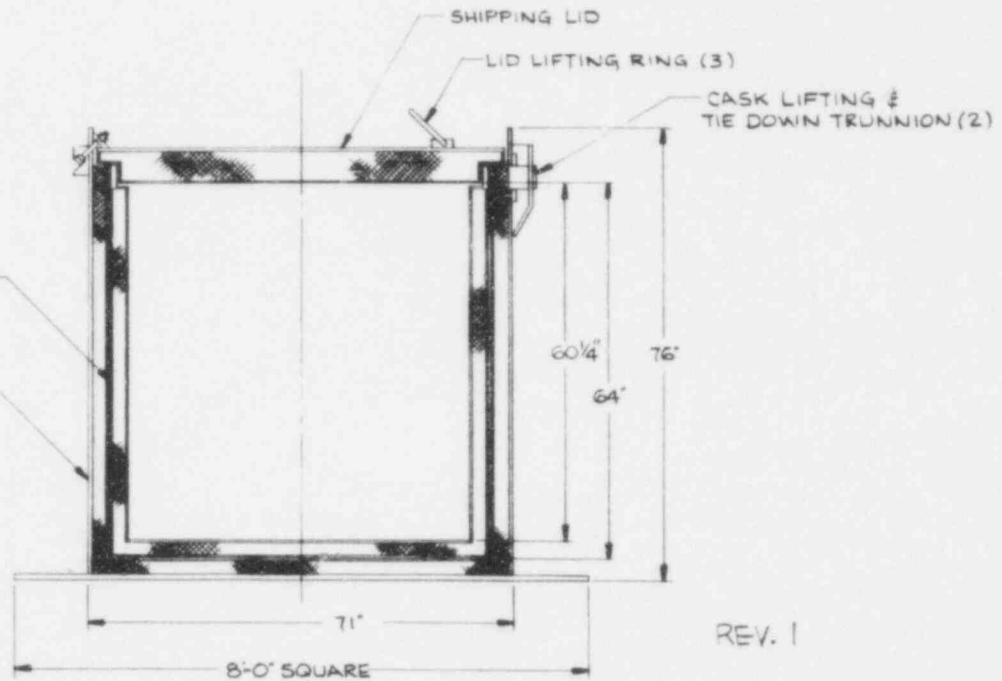
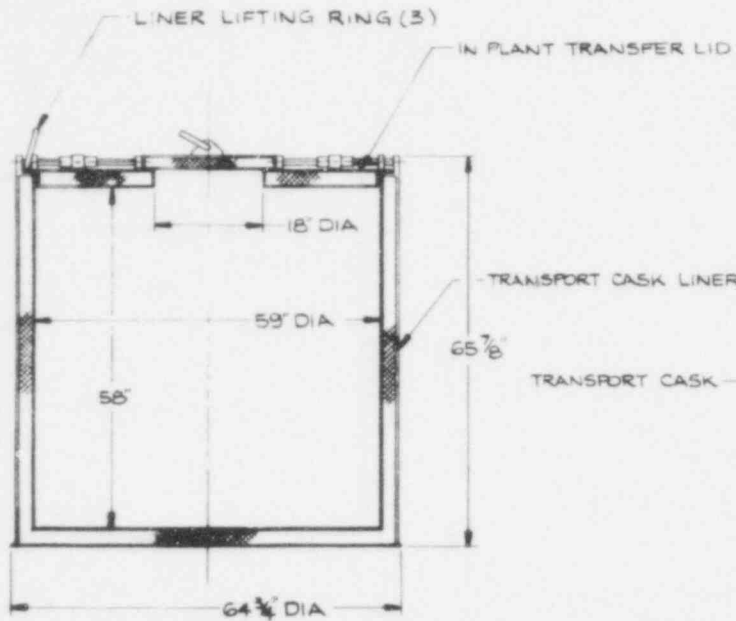
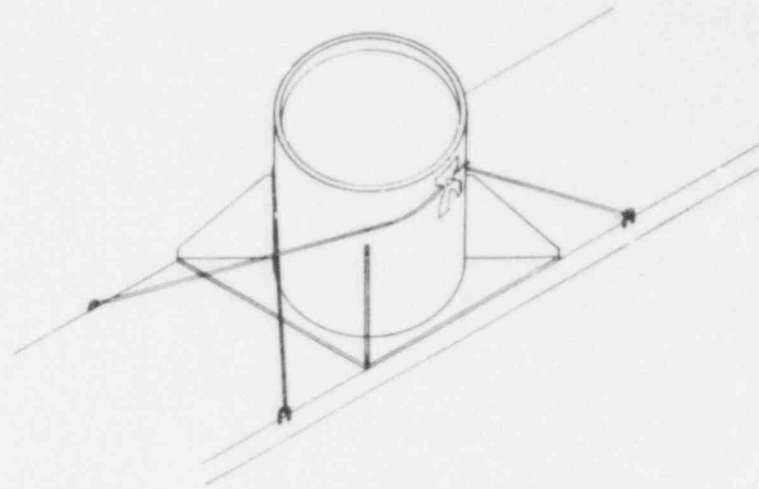
WEIGHT

TRANSPORT CASK W/O LINER - 32,220 LBS. EMPTY

TRANSPORT CASK LID - 6,500 LBS.

TRANSPORT CASK LINER W/O LID - 15,280 LBS. EMPTY

TRANSPORT CASK LINER LID - 3,020 LBS.



REV. 1

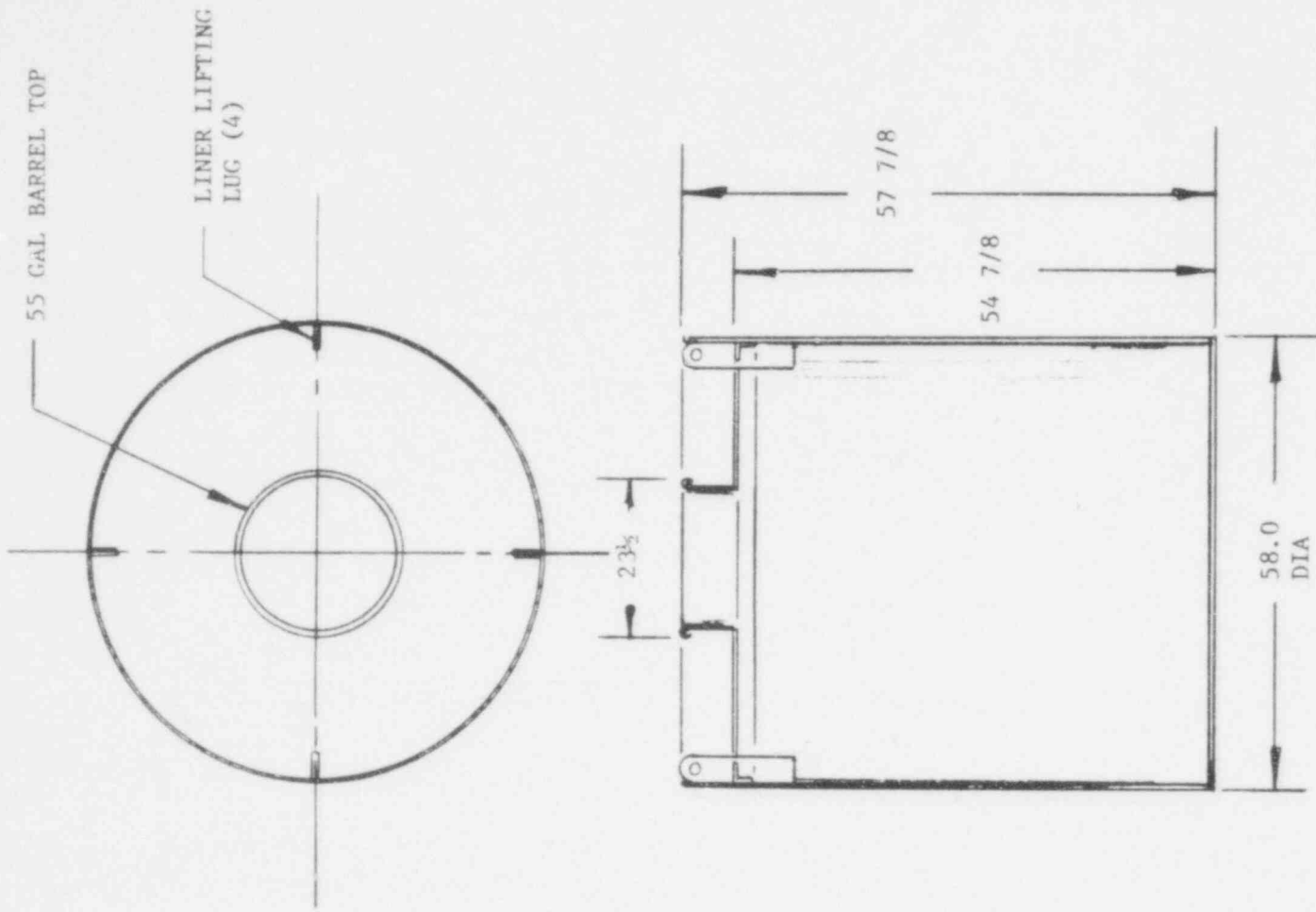
701 185

CHEM-NUCLEAR SYSTEMS, INC.

LINER, SOLID WASTE

USED ON CASK 6-80

CAPACITY 85 CU. FT.

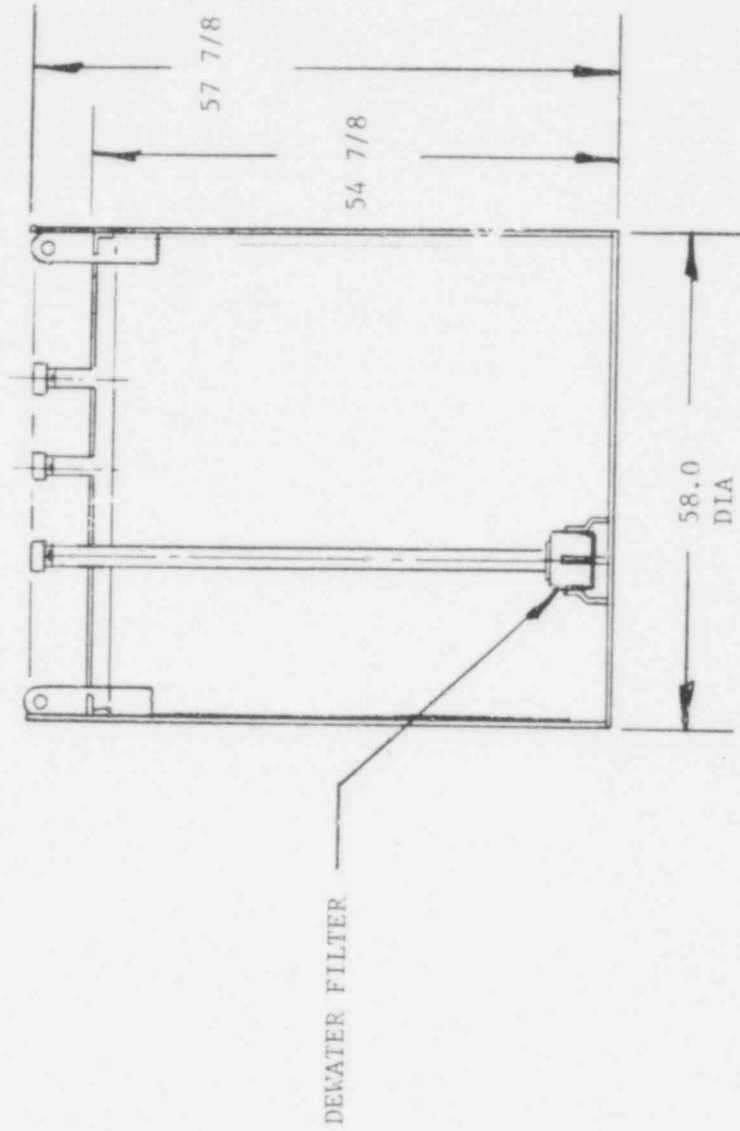
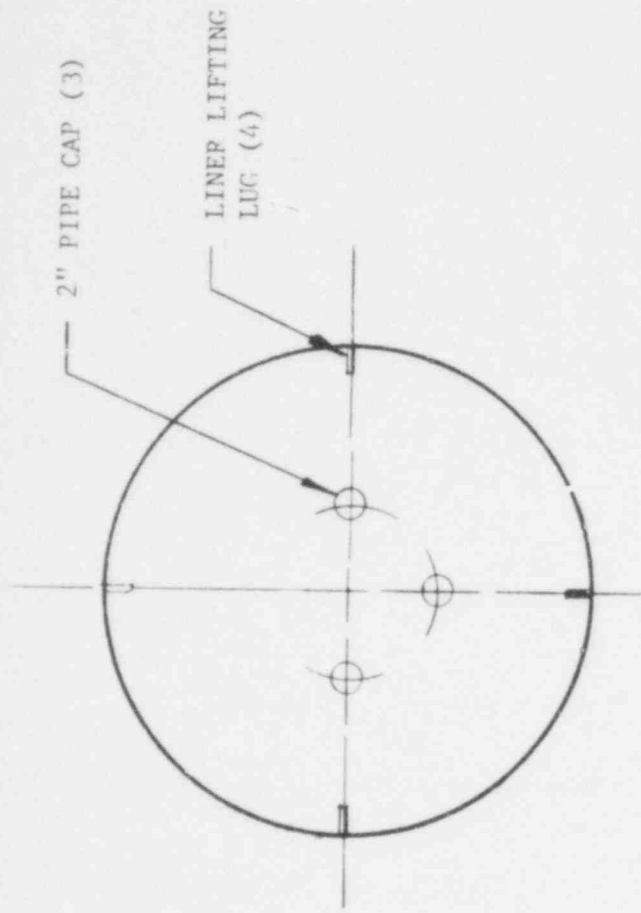




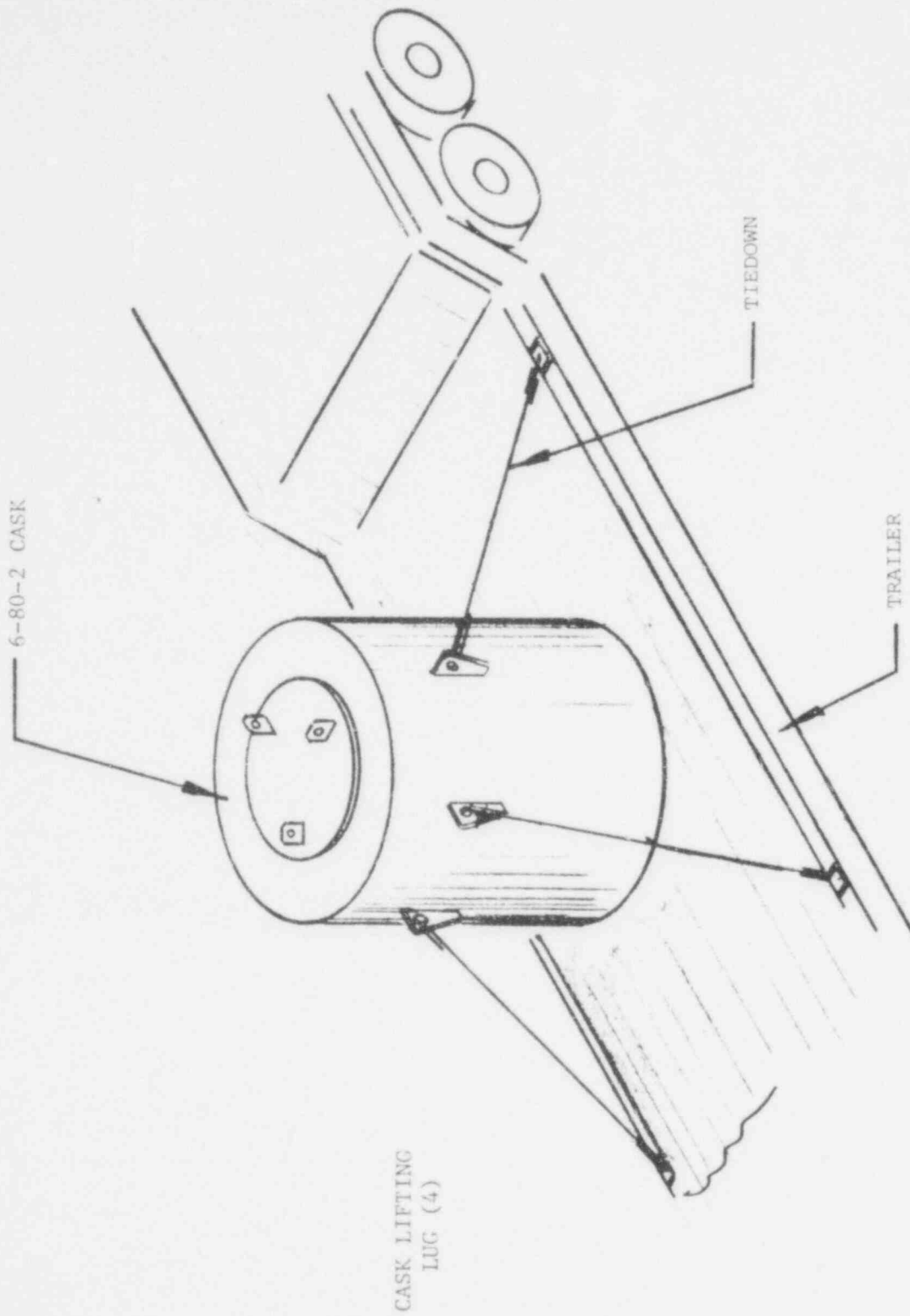
LINER--RESIN

USED ON CASK 6-80

CAPACITY 85 CU. FT.



701 187



CNS 6-80-2

TRANSPORT CASK 6-80-2

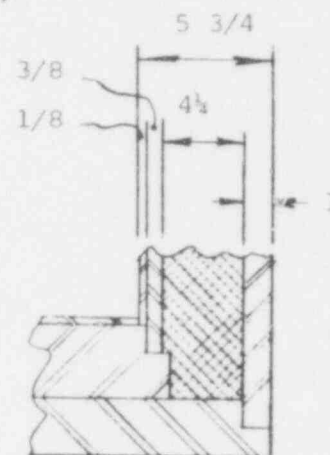
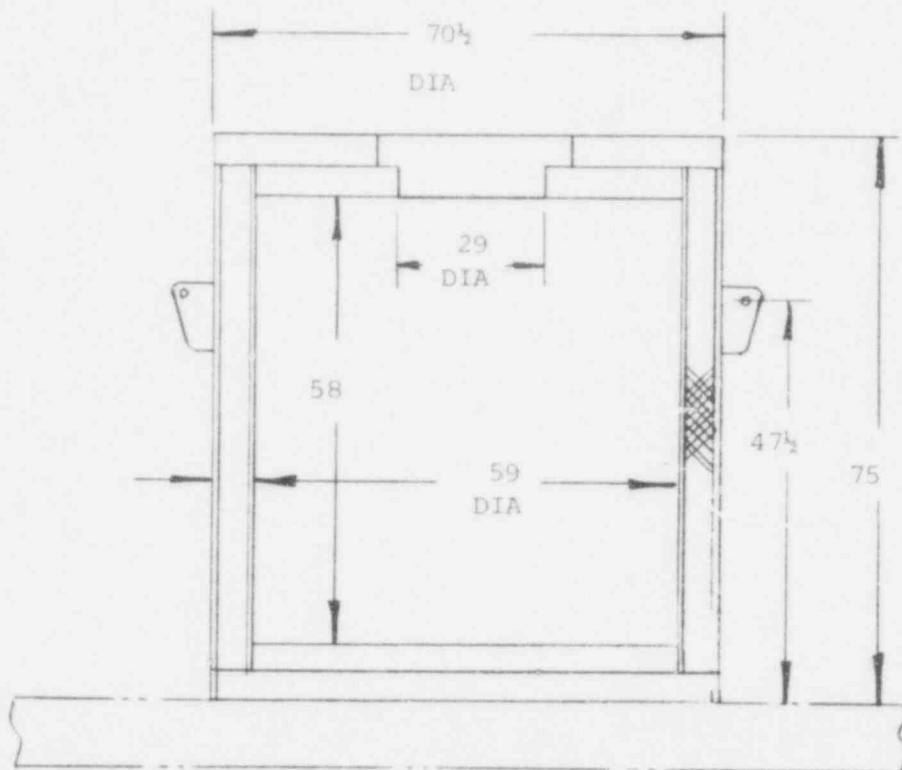
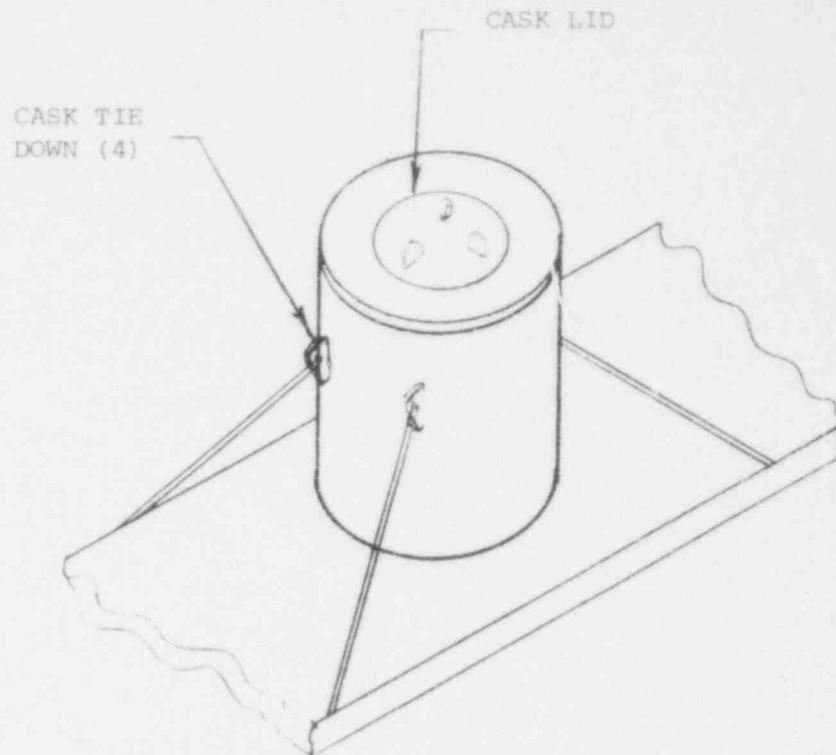
SHIELDING: 5.0 IN. LEAD EQUIV.

TYPE: USA/9111/A

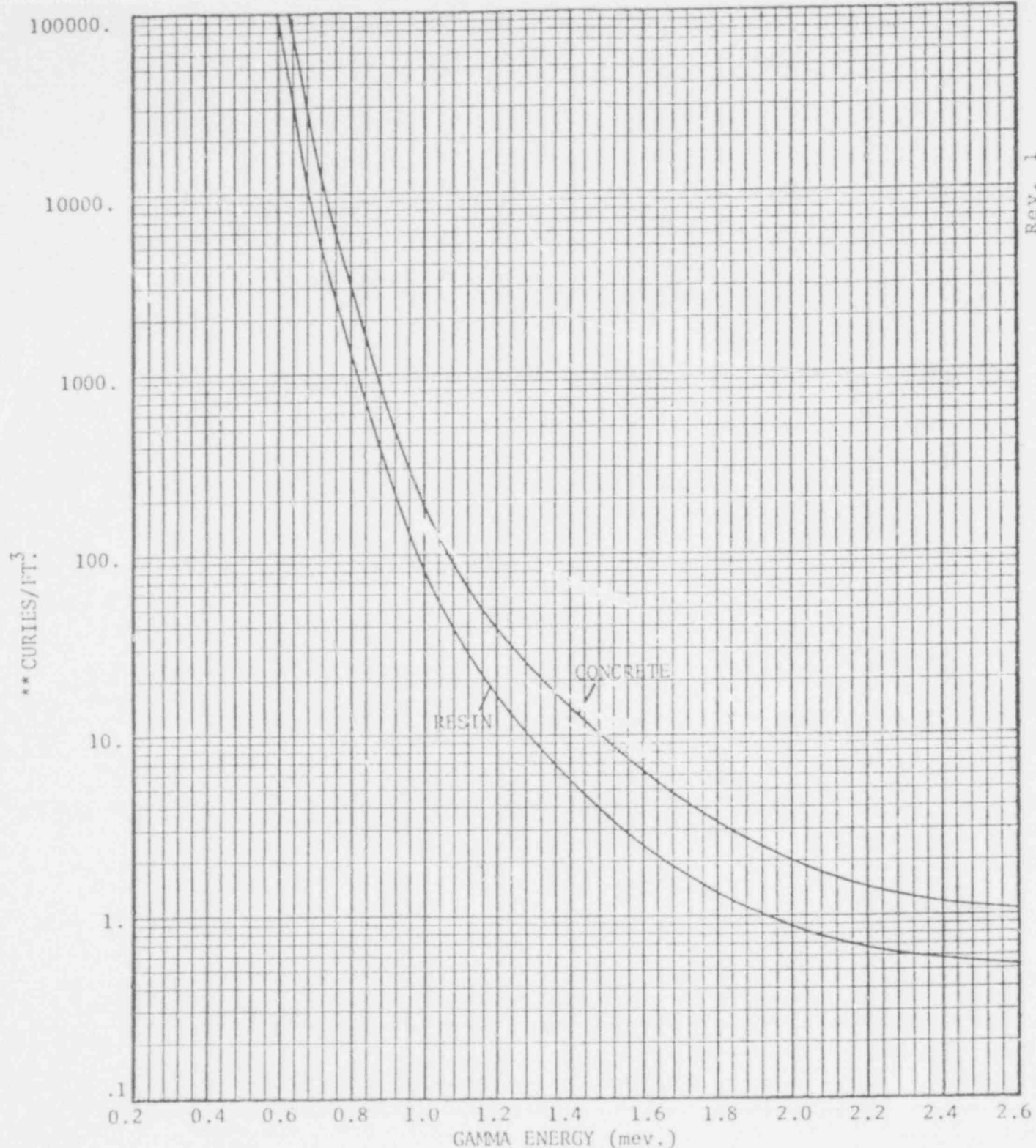
CAPACITY: (1) 85 CU. FT. CONTAINER OR

(6) 55 GAL. DRUMS

WEIGHT: GROSS WT. (EMPTY): 44,000 LBS.



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\*\*BASED ON HOMOGENEOUS MIX

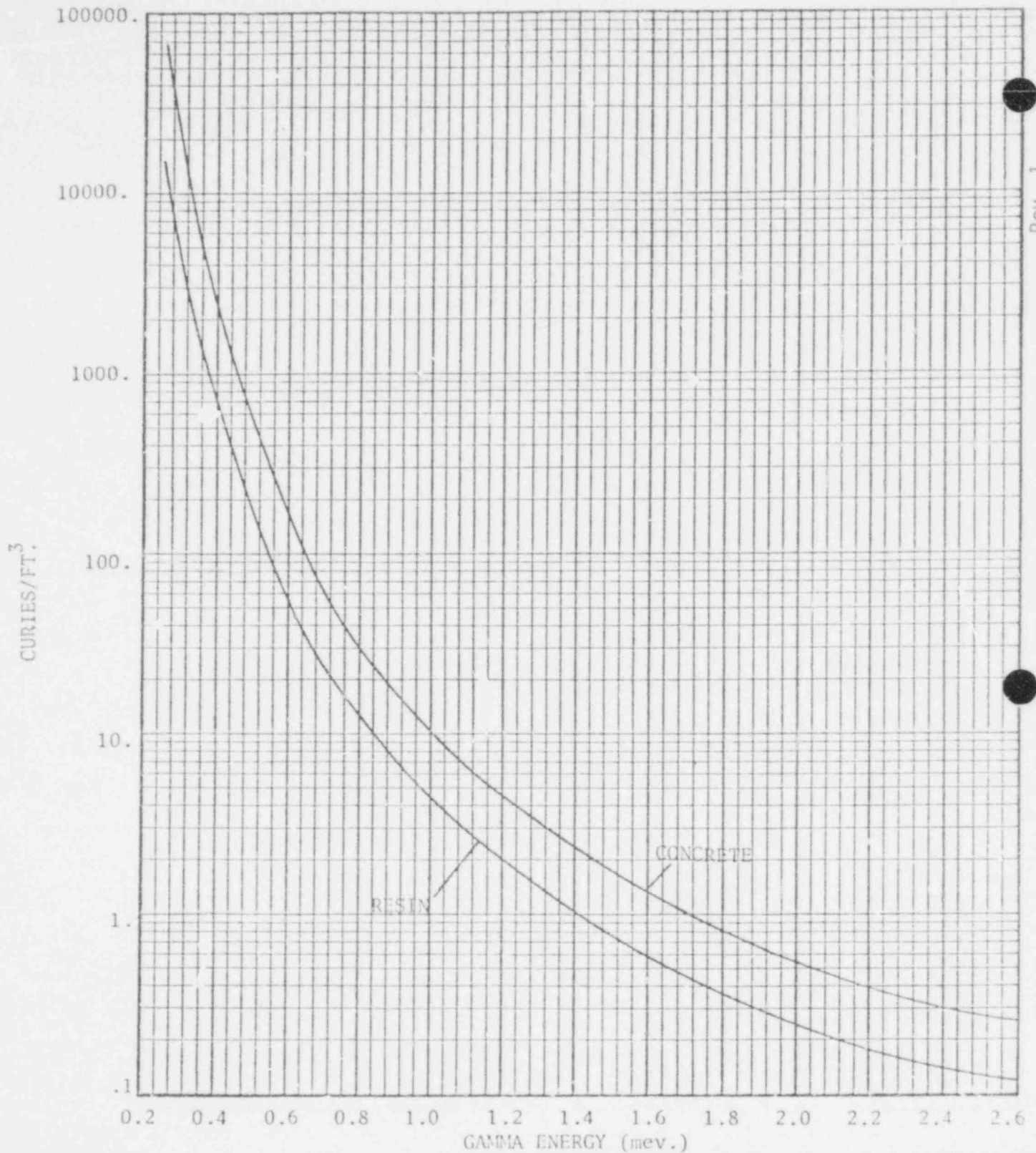
DOSE RATE AT 6 FEET FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK 6-80 1 INCH STEEL, 4-1/4 INCHES LEAD, 3/8 INCHES STEEL SHIELDING ON SIDE

701 190

REV.	DATE	SHEET
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# CHEM-NUCLEAR SYSTEMS, INC.

CASK 6-80 8 INCHES STEEL  
SHIELDING ON TOP

701 191

REV.

DATE

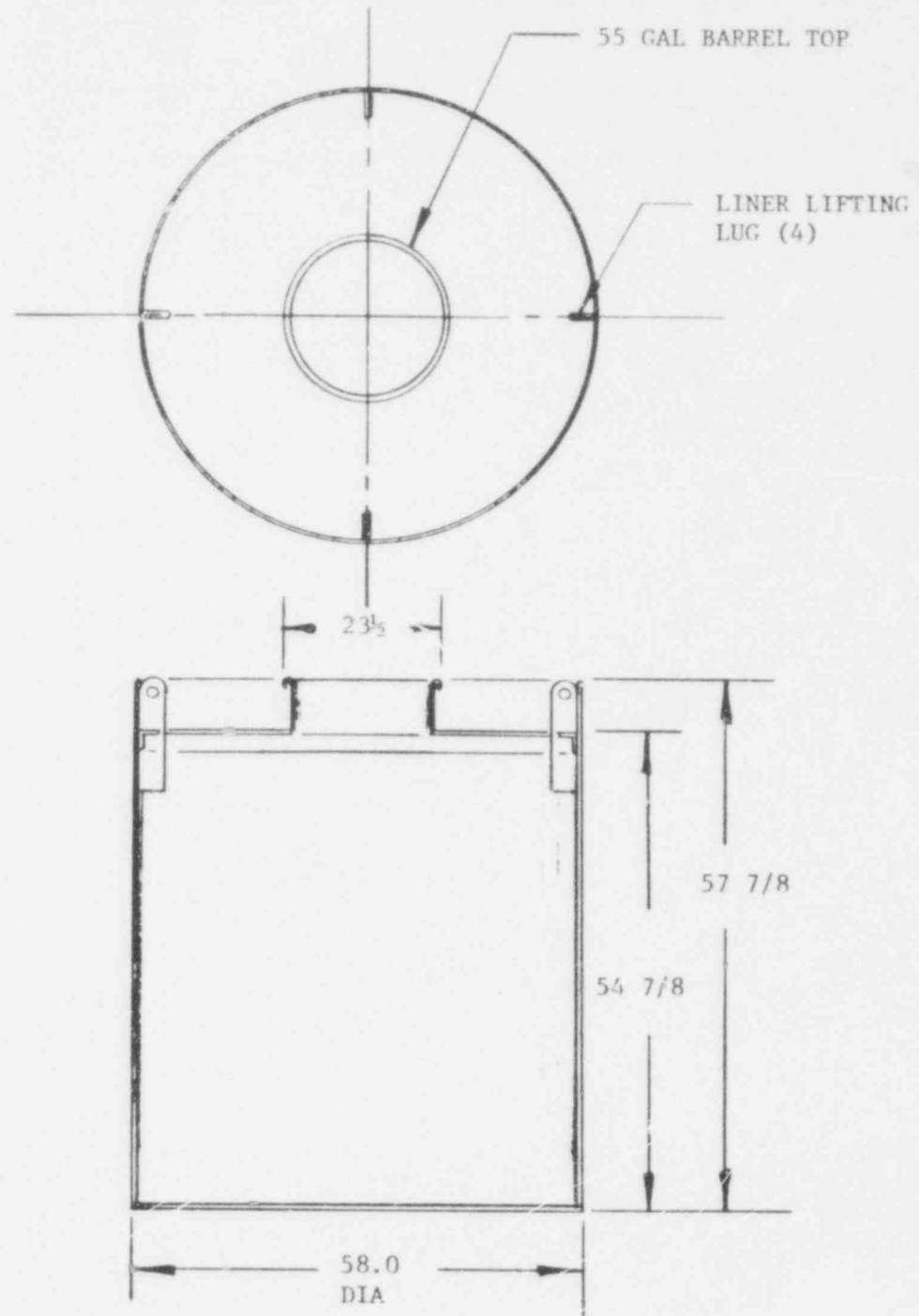
SHEET

CHEM-NUCLEAR SYSTEMS, INC.

LINER, SOLID WASTE

USED ON CASK 6-80

CAPACITY 85 CU. FT.



701 192

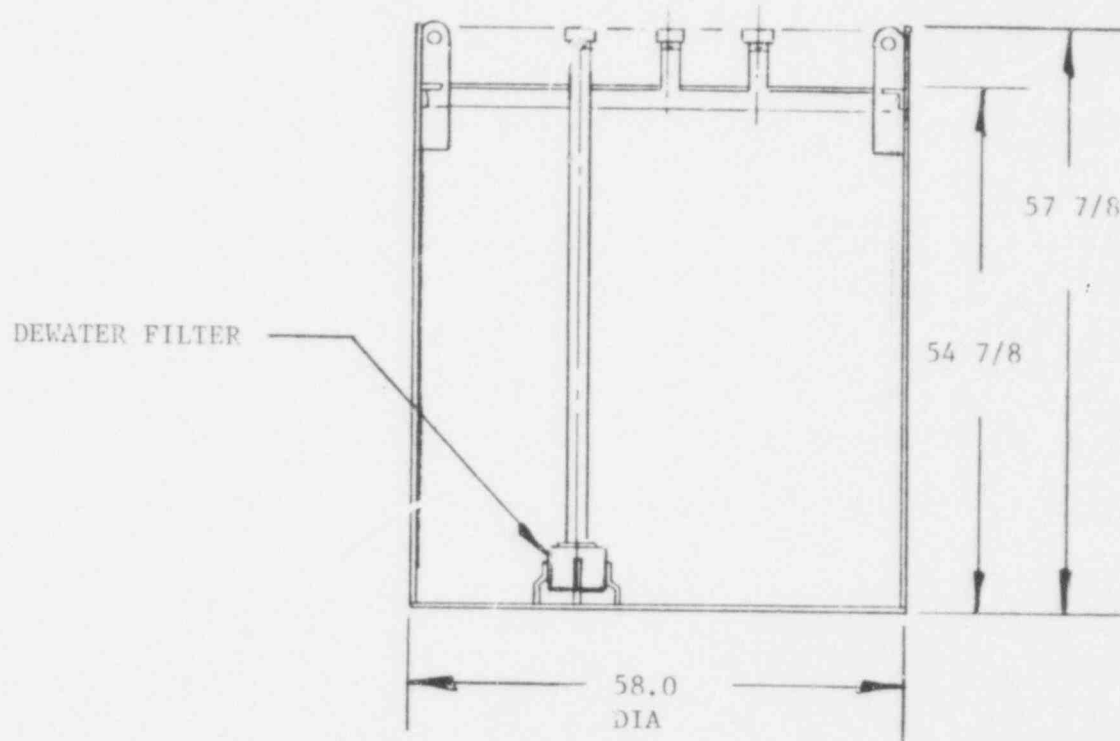
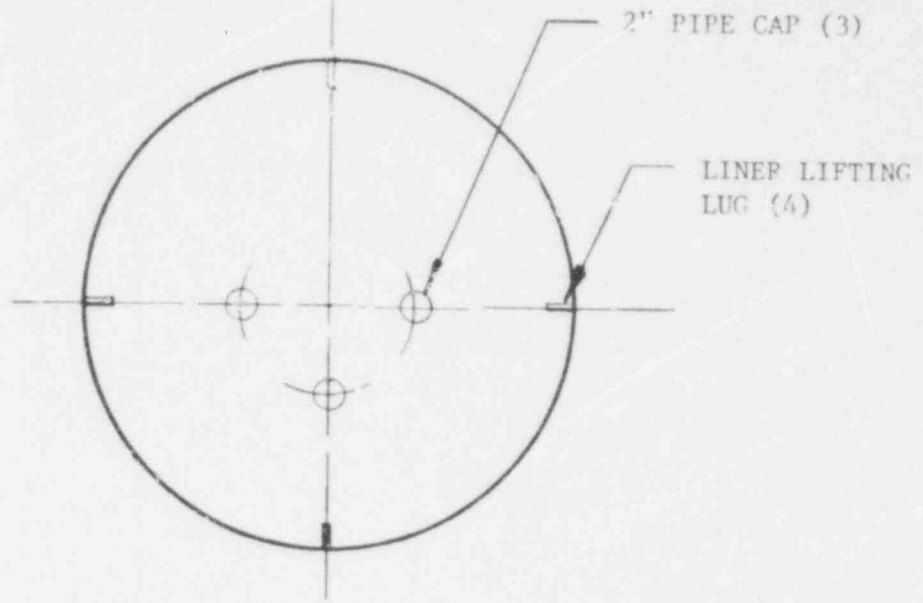
Rev. 1

CHEM-NUCLEAR SYSTEMS, INC.

LINER-RESIN

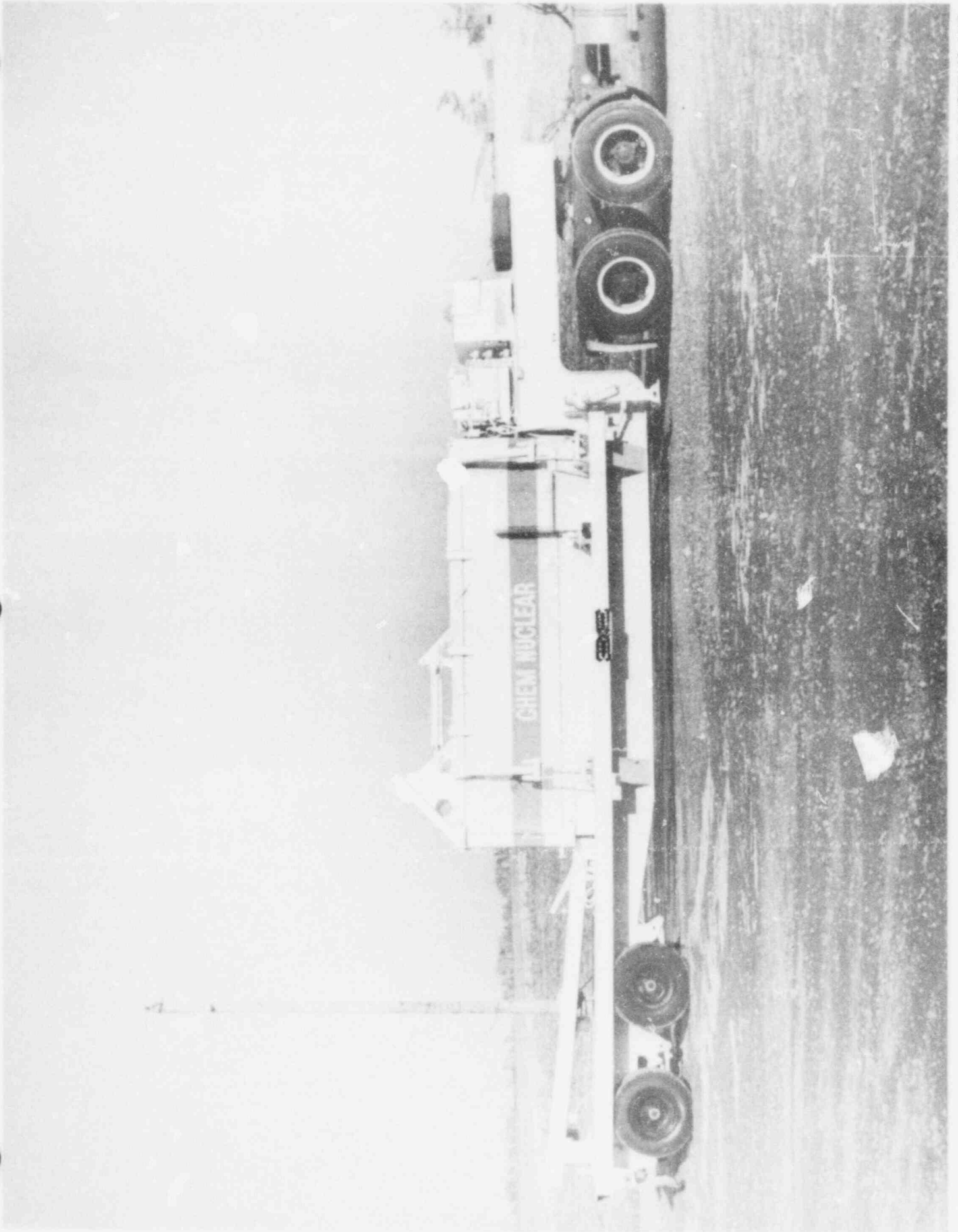
USED ON CASK 6-80

CAPACITY 85 CU. FT.



701 193

Rev. 1



CHEM-NUCLEAR SYSTEMS, INC.  
CNS 6-101 Rev. 1

POOR ORIGINAL

701 194



**CHEM-NUCLEAR SYSTEMS, INC.**

SIX DRUM LSA SHIELD TRANSPORT CASK

SERIAL NO. CNS- 6-101

SHIELD THICKNESS: 4" OF STEEL & 1" OF LEAD (325" LEAD EQV.)  
U.S.N.R.C. PACKAGE IDENT. NO. U.S.A./9105/A

DOSE RATE LIMITATIONS (AT SURFACE OF DRUM OR CONTAINER):  
60 R/HR WITH NO SUPPLEMENTAL SHIELDING

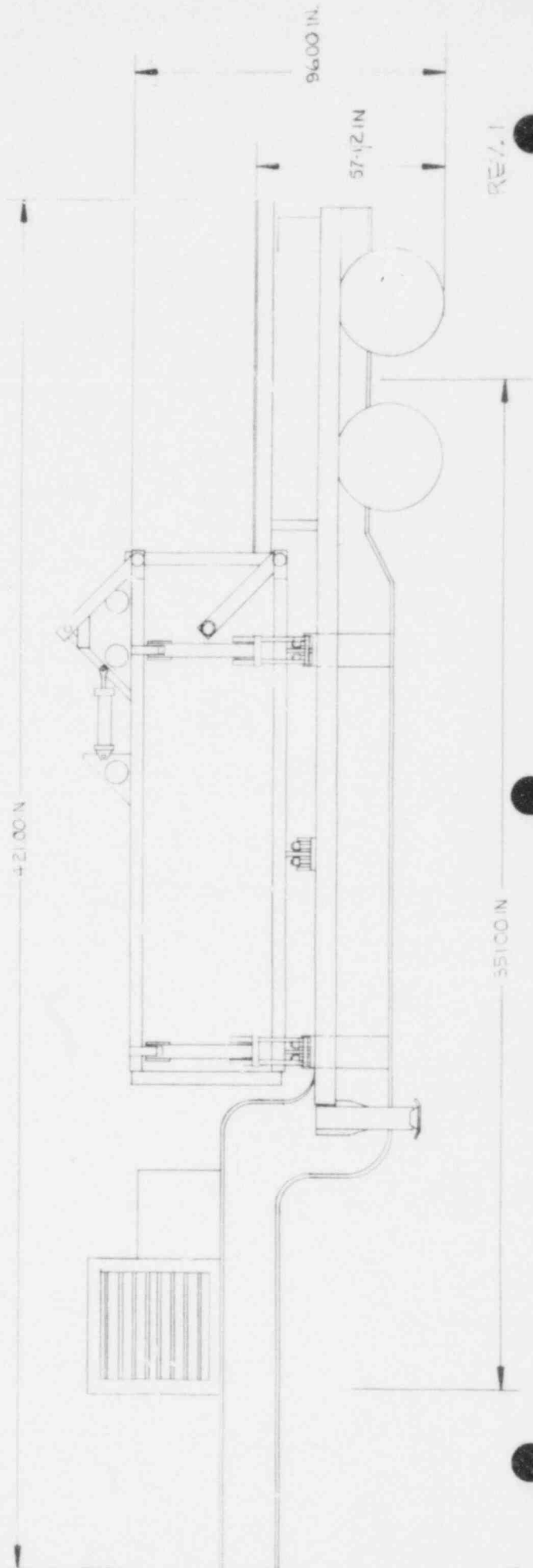
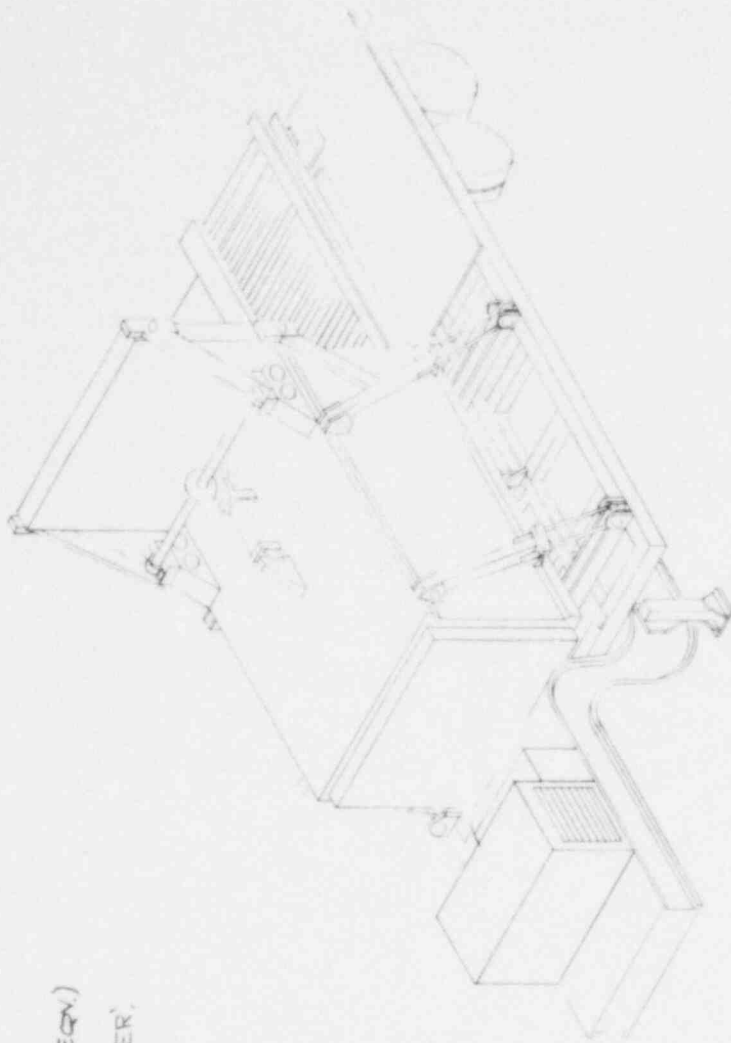
CAPACITY

(6) 55 GAL DRUMS

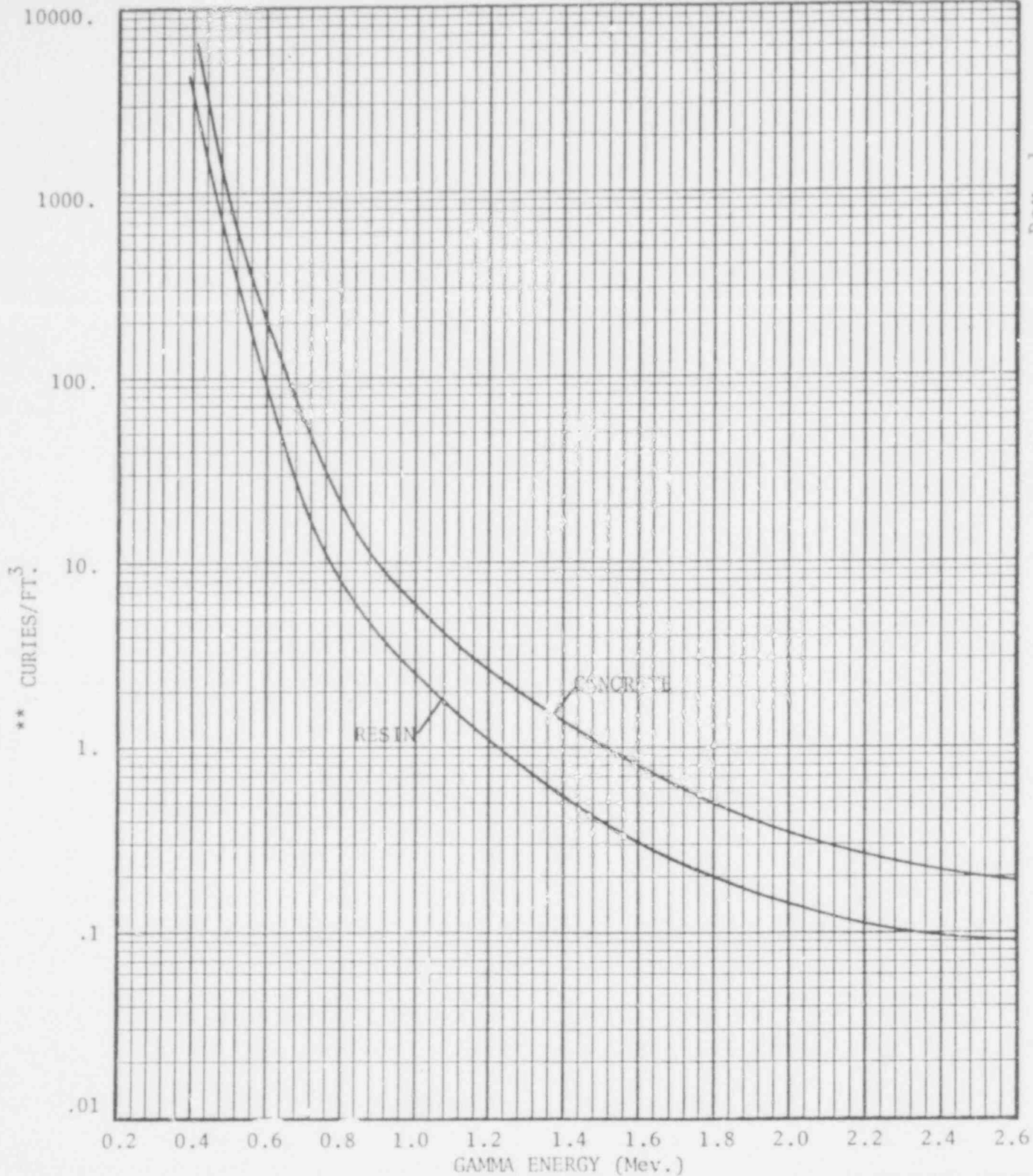
CAVITY: 34" WIDE x 40" HIGH x 13'-0" LONG

MODE OF TRANSPORTATION

AUTO LOADER



701 195



\*\* CURIES/FT<sup>3</sup>

RESIN

CONCRETE

GAMMA ENERGY (Mev.)

### CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX

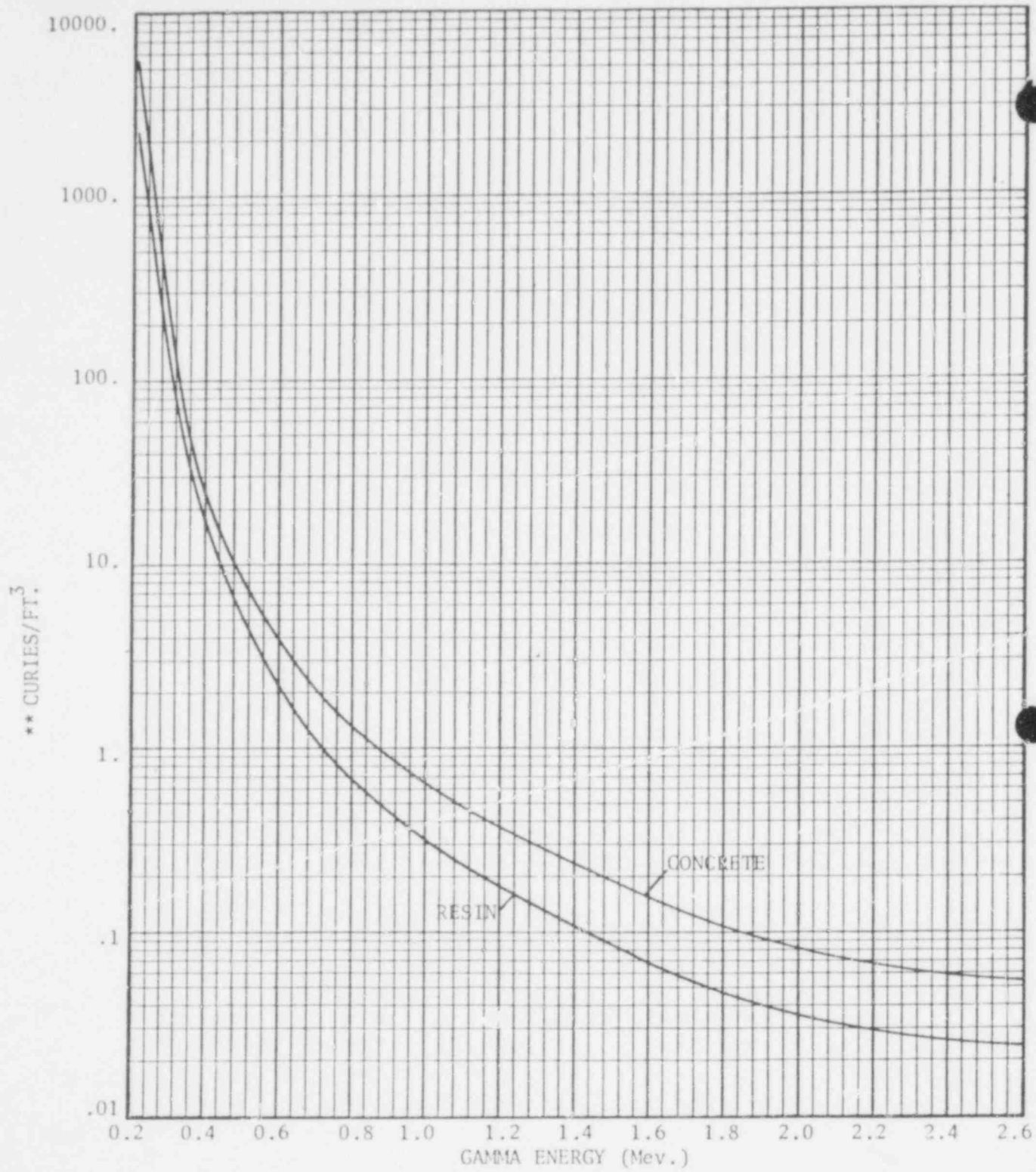
DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

CASK 6-101 5 INCHES STEEL, 1 INCH LEAD,  
1/4 INCH STEEL  
SHIELDING ON SIDE 701 196

REV.

DATE

SHEET



Rev. 1

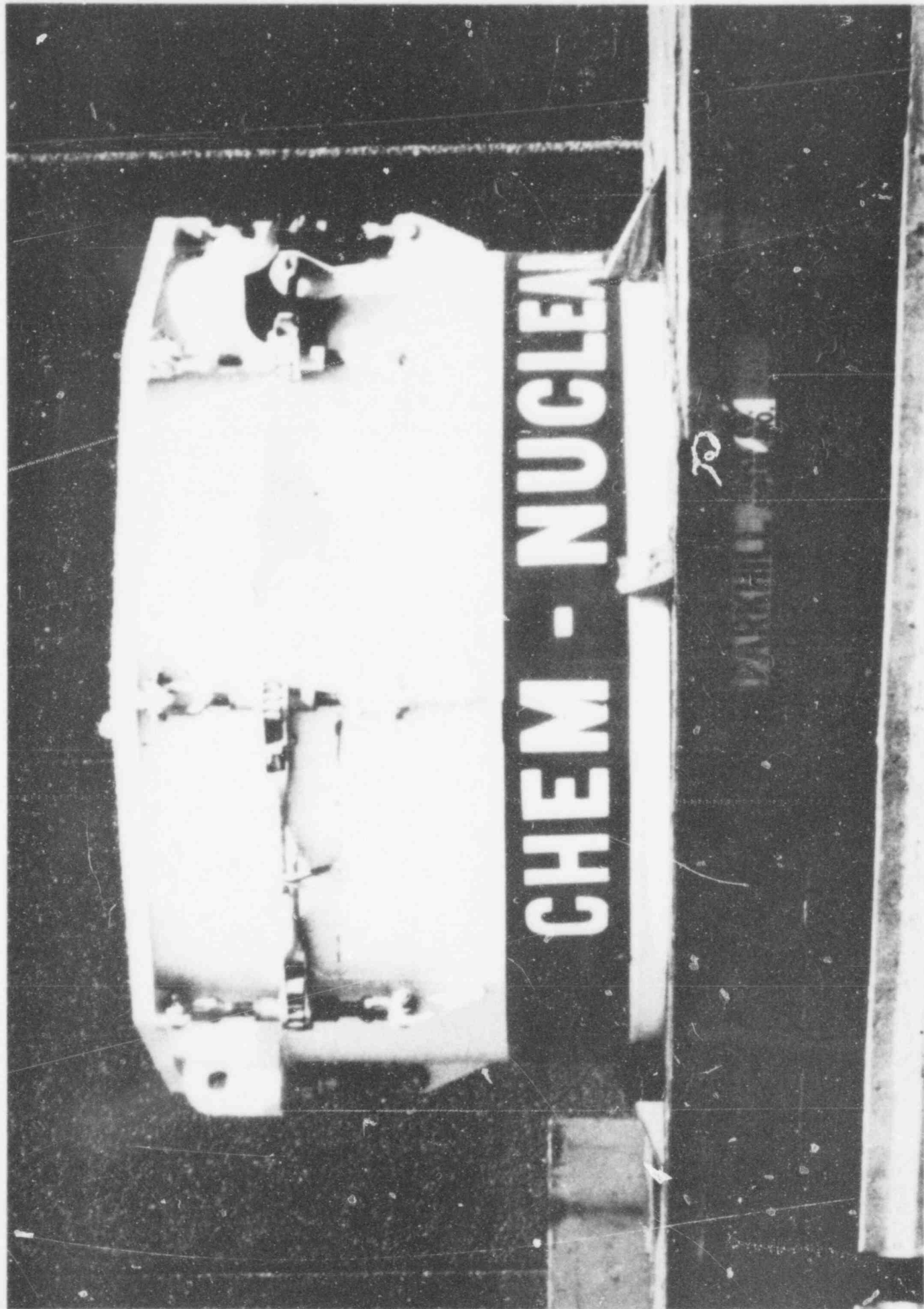
\*\*BASED ON HOMOGENEOUS MIX  
DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK 6-101 5 INCHES STEEL  
SHIELDING ON TOP

701 197

REV.	DATE	SHEET
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POOR ORIGINAL 701 198

# CHEM-NUCLEAR SYSTEMS, INC.

CNS 7-100

SHIELDING: 3.50 IN LEAD EQUIV.

USNRC PACKAGE IDENT. NO. U.S.A./9113/A

## CAPACITY

(7) 55 GAL. DRUMS OR

(1) 87 CU.FT. CONTAINER

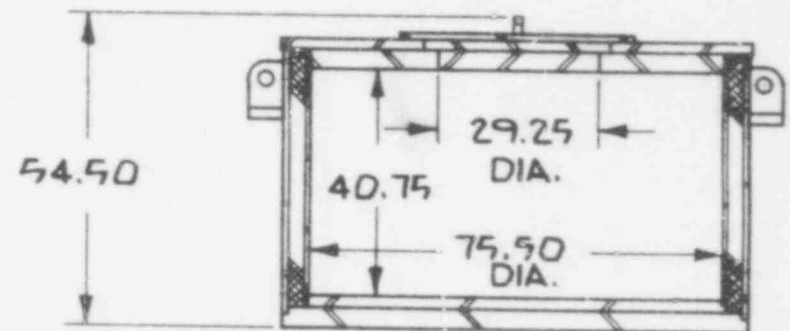
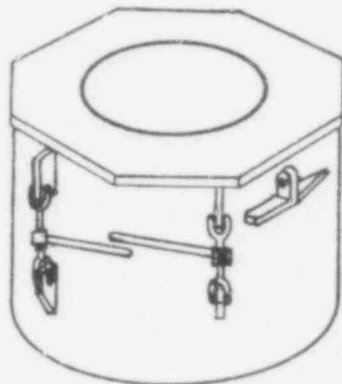
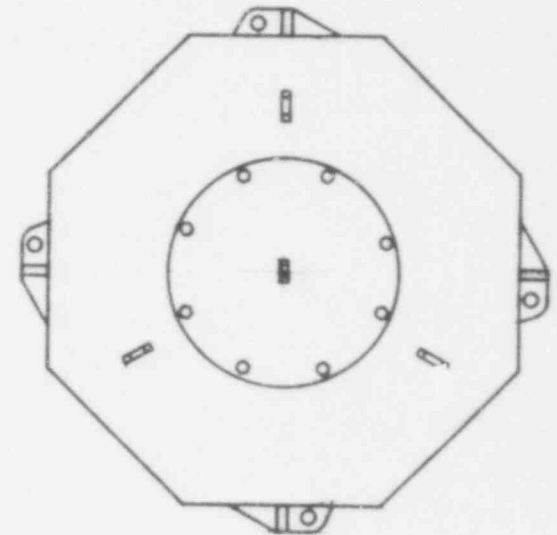
## WEIGHT

GROSS WEIGHT: 35,000 LBS EMPTY

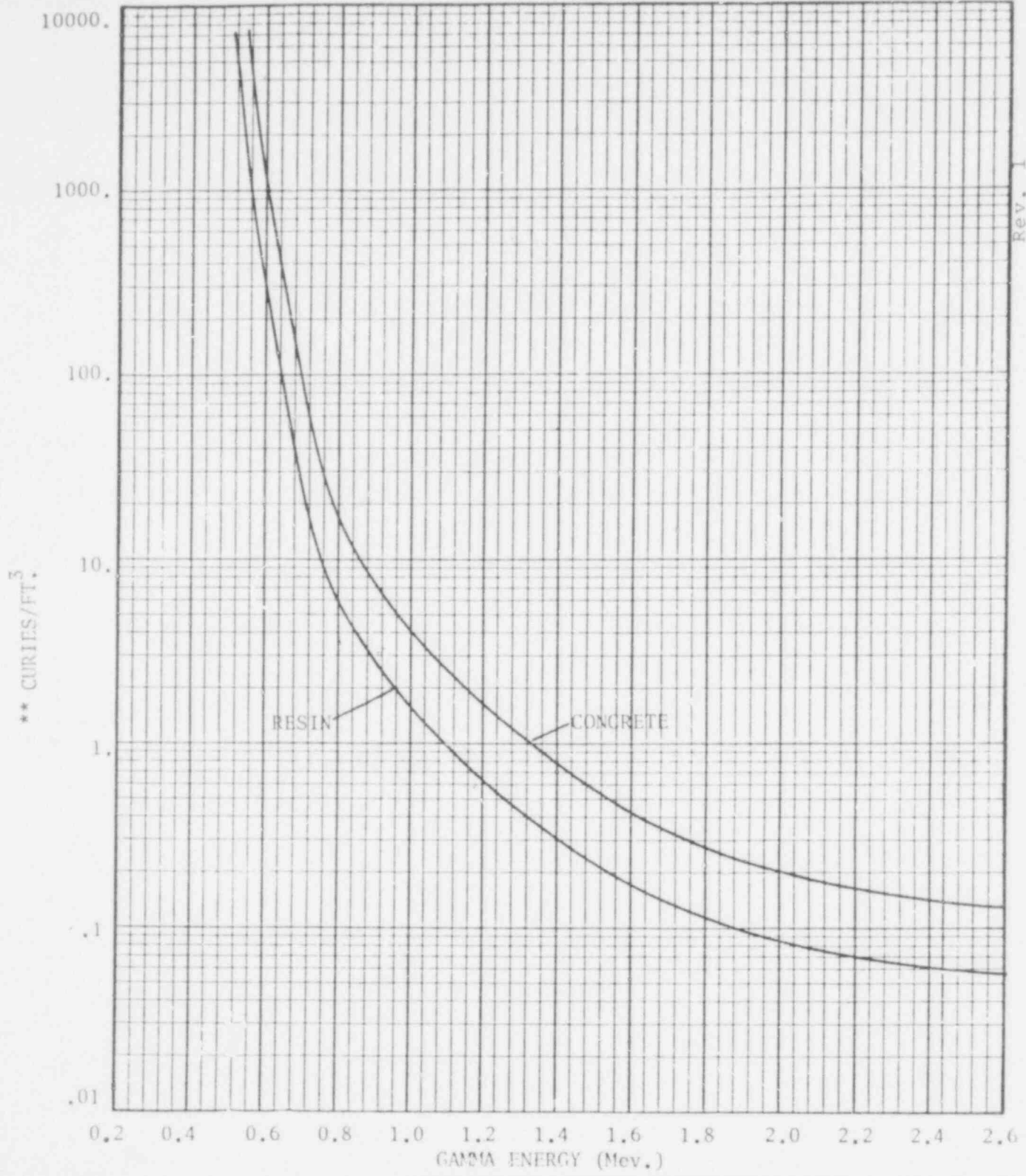
CASK LID: 15,750

## MODE OF TRANSPORTATION

MARINE OR MOTOR VEHICLE



701 199



Rev. 1

\*\* CURIES/FT<sup>3</sup>

RESIN

CONCRETE

GAMMA ENERGY (Mev.)

## CHEM-NUCLEAR SYSTEMS, INC.

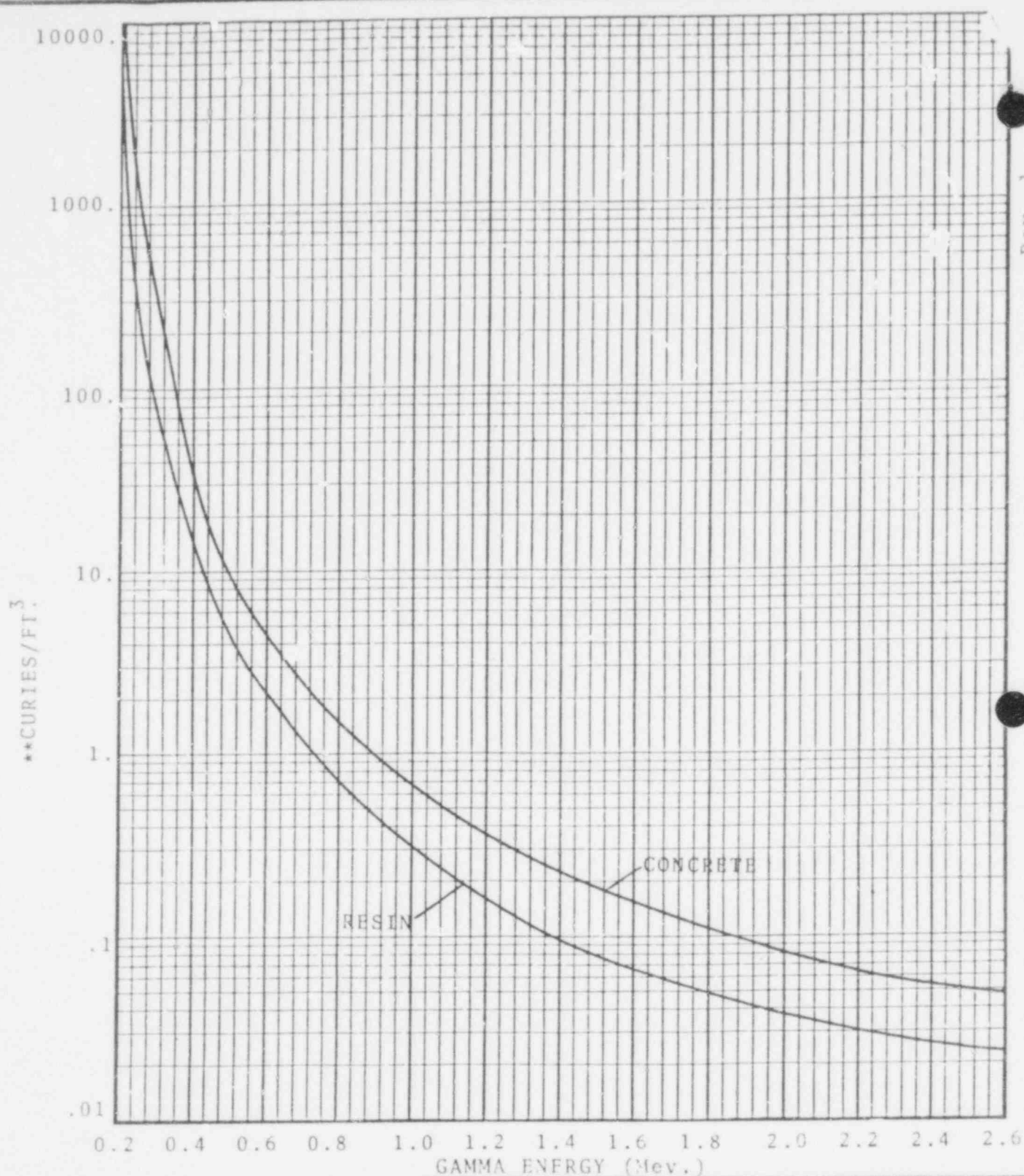
\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

CASK 7-100 1-1/8 INCHES STEEL,  
3 INCHES LEAD  
SHIELDING ON SIDE

701 200

REV.	DATE	SHEET



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\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK 7-100 5-1/2 INCHES STEEL  
SHIELDING ON TOP

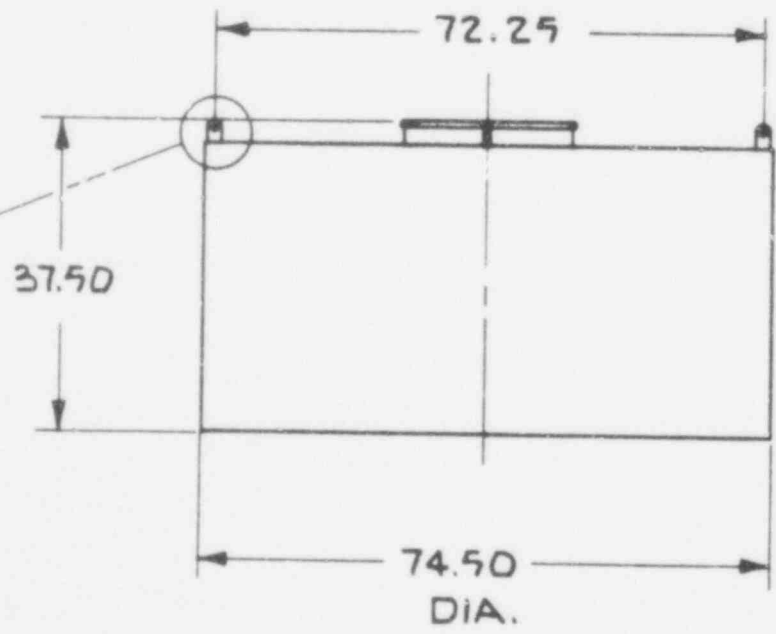
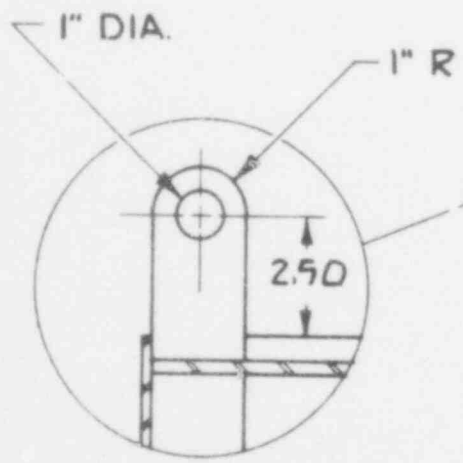
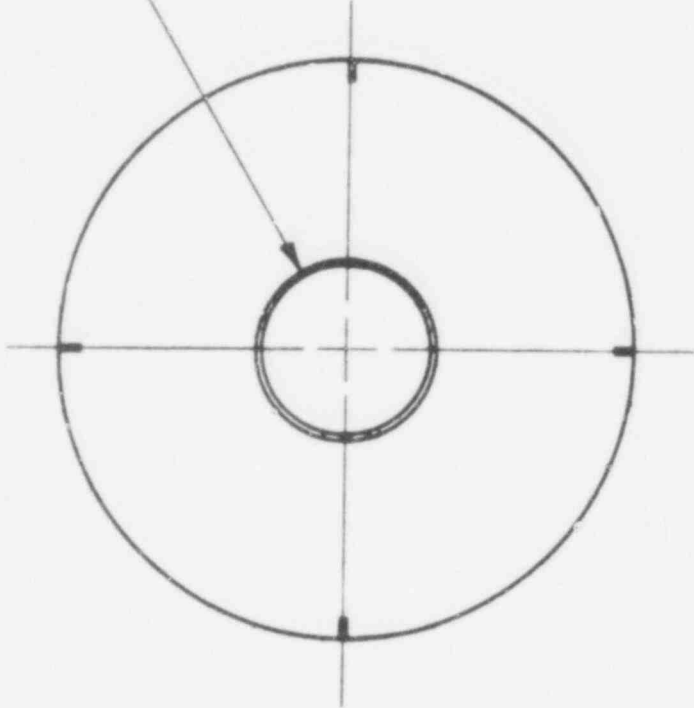
701 201

REV.	DATE	SHEET
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DISPOSABLE CONTAINER  
7-100 CASK  
CAPACITY 87 CU.FT.

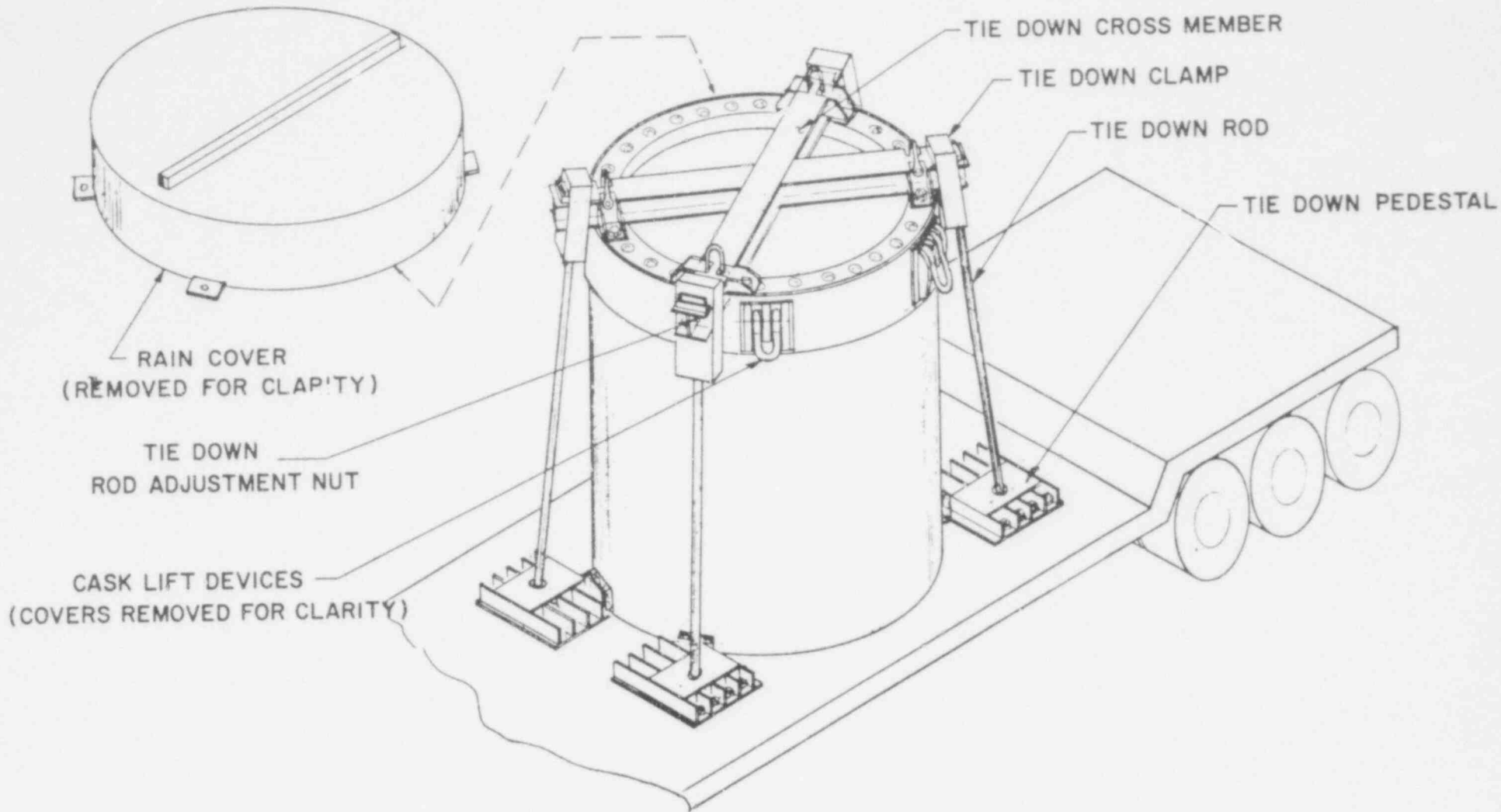
Rev. 1

55 GAL. DRUM-TYPE OPENING



701 202





LL-50-100

(CNS 8-120)

701 203

TRANSPORT CASK

ATCOR LL-50-100 (GNS 8-120)

SHIELDING: 4.5 IN. LEAD EQUIV.

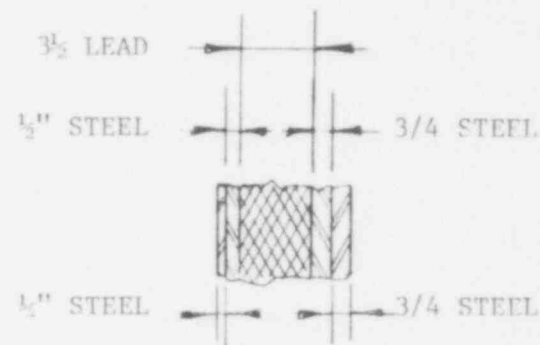
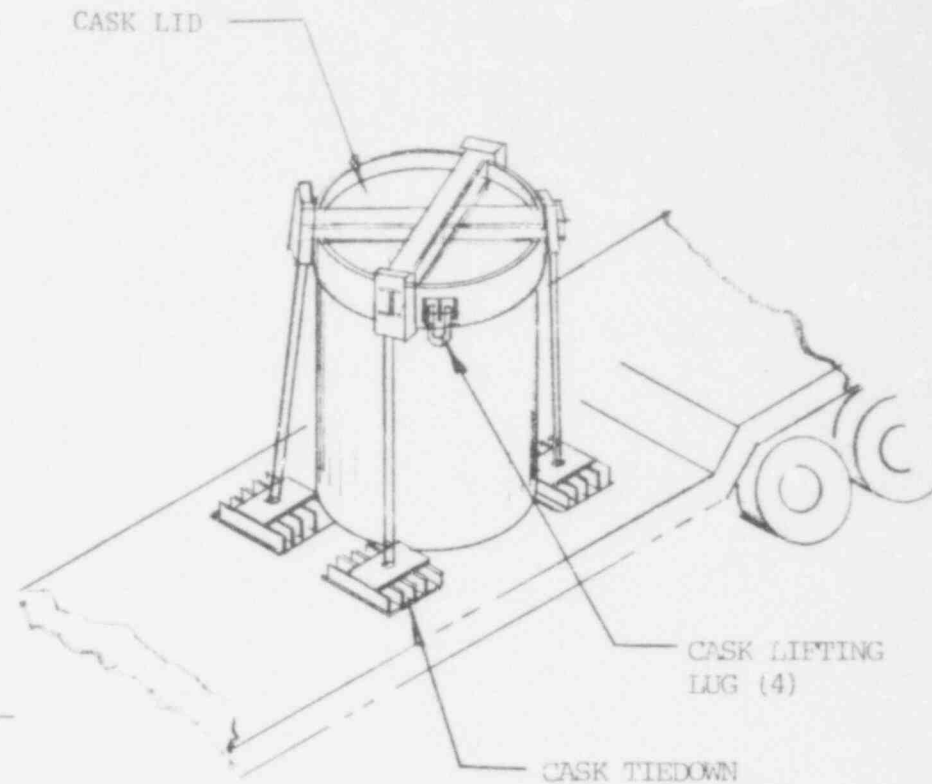
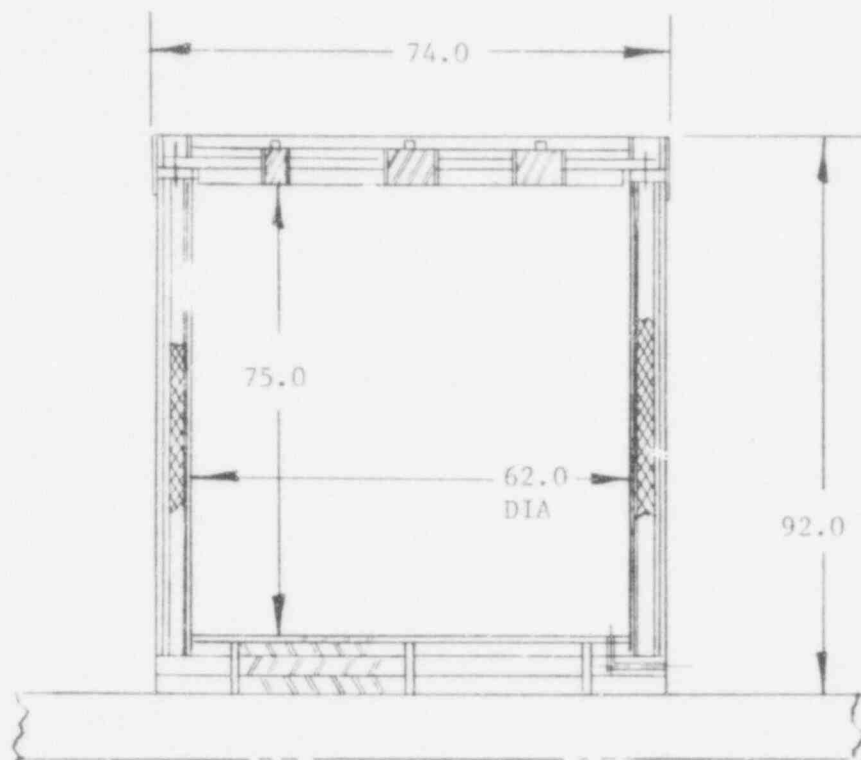
TYPE B - USA/6601/B

CAPACITY: (8) 55 GAL. DRUMS OR

(1) 124 CU. FT. CONTAINER

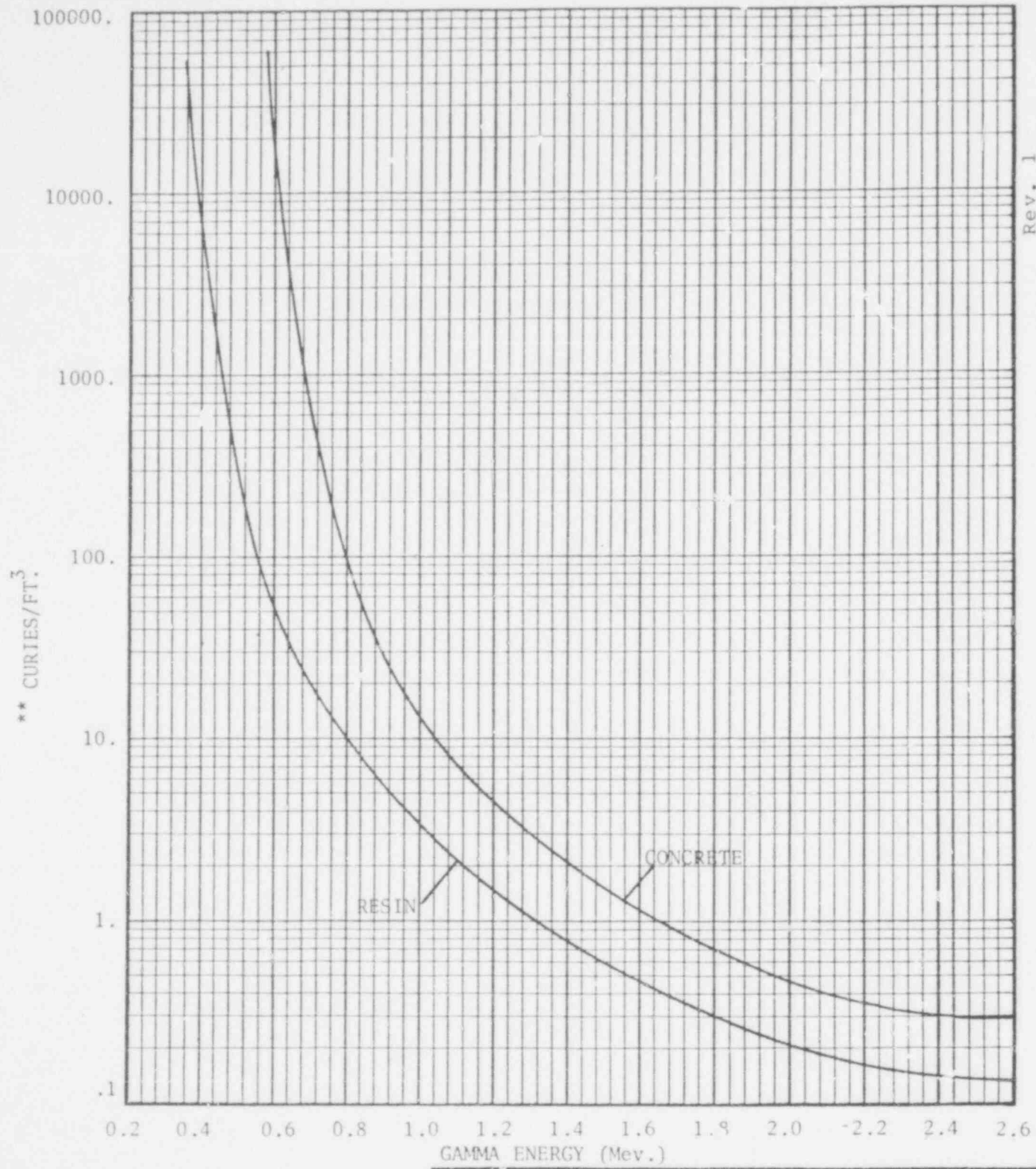
WEIGHT: GROSS WT. (EMPTY) 58,000 LBS.

CASK LID 6,600 LBS.



TYP. WALL SECTION

701 204



\*\*BASED ON HOMOGENEOUS MIX

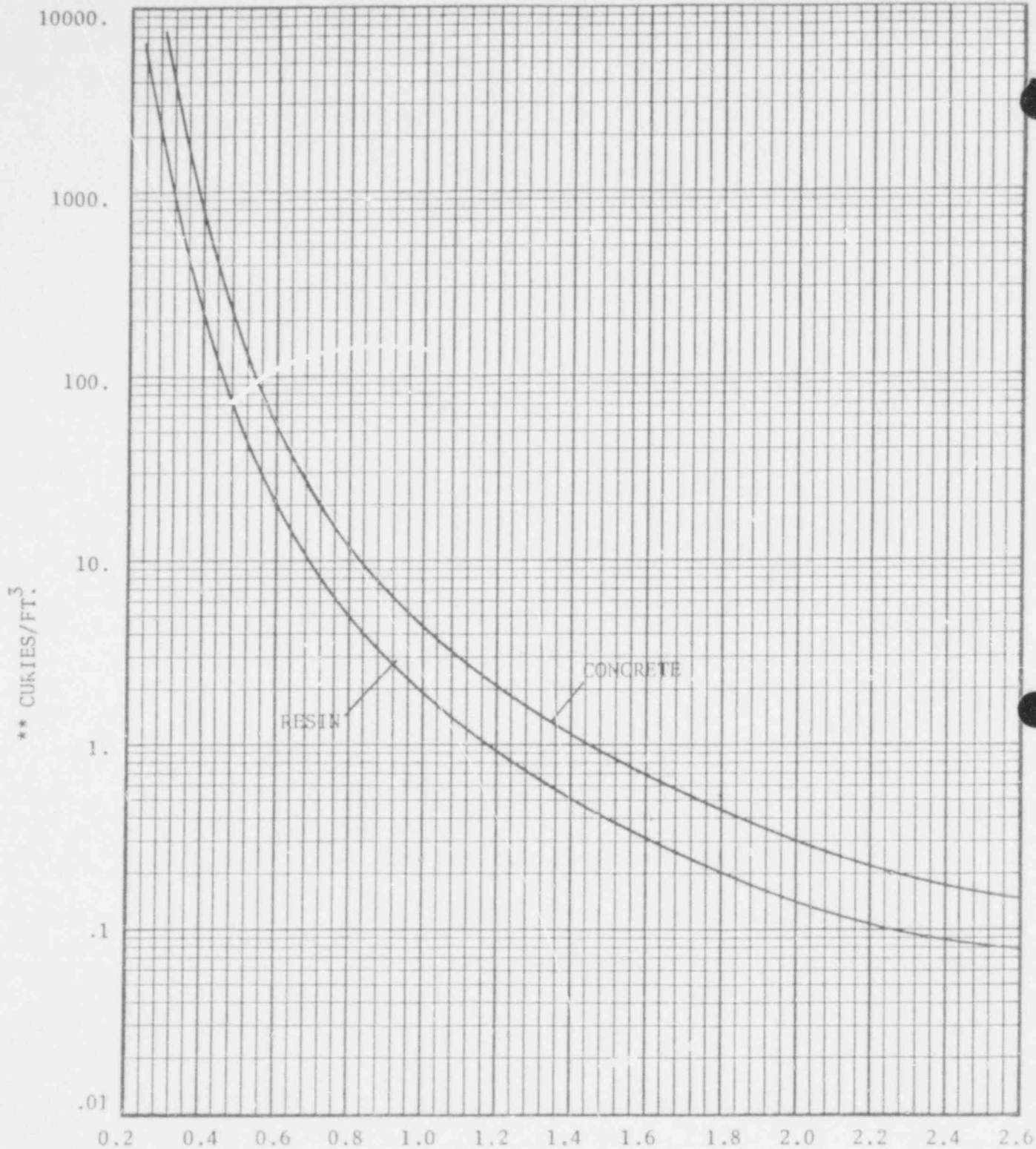
DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

701 205

### CHEM-NUCLEAR SYSTEMS, INC.

CASK: CNS 8-120  
(CASK LL-50-100) 1-1/2 INCHES STEEL,  
3-1/2 INCHES LEAD,  
3/4 INCH STEEL  
SHIELDING ON SIDE

REV.	DATE	SHEET
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\*\* CURIES/FT.³

RESIN

CONCRETE

### CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

CASK: CNS 8-120  
(CASK LL-50-100) 7 INCHES STEEL  
SHIELDING ON TOP

701 206

REV.	DATE	SHEET
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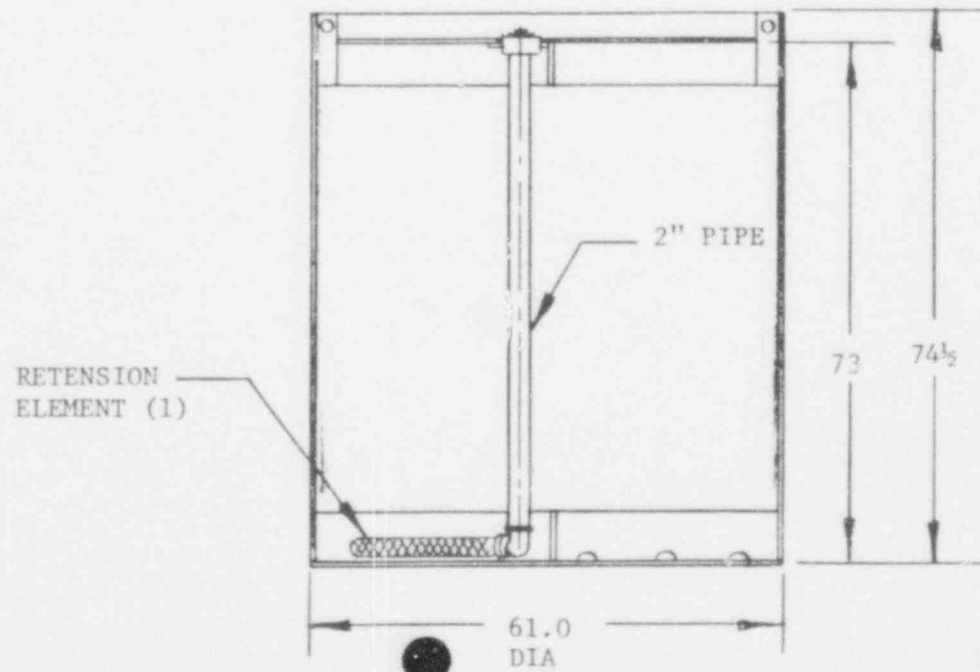
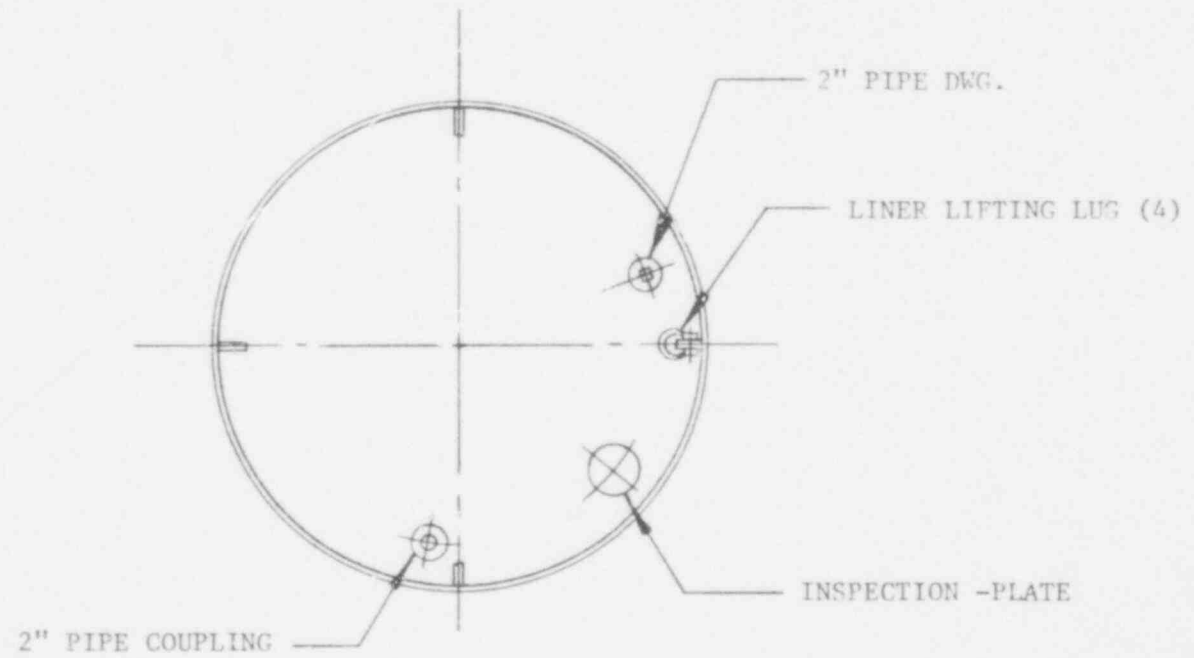
CHEM-NUCLEAR SYSTEMS, INC.

LINER - RESIN

USED ON CASK LL-50-100 (CNS 8-120)

CAPACITY 124 CU. FT.

701 207

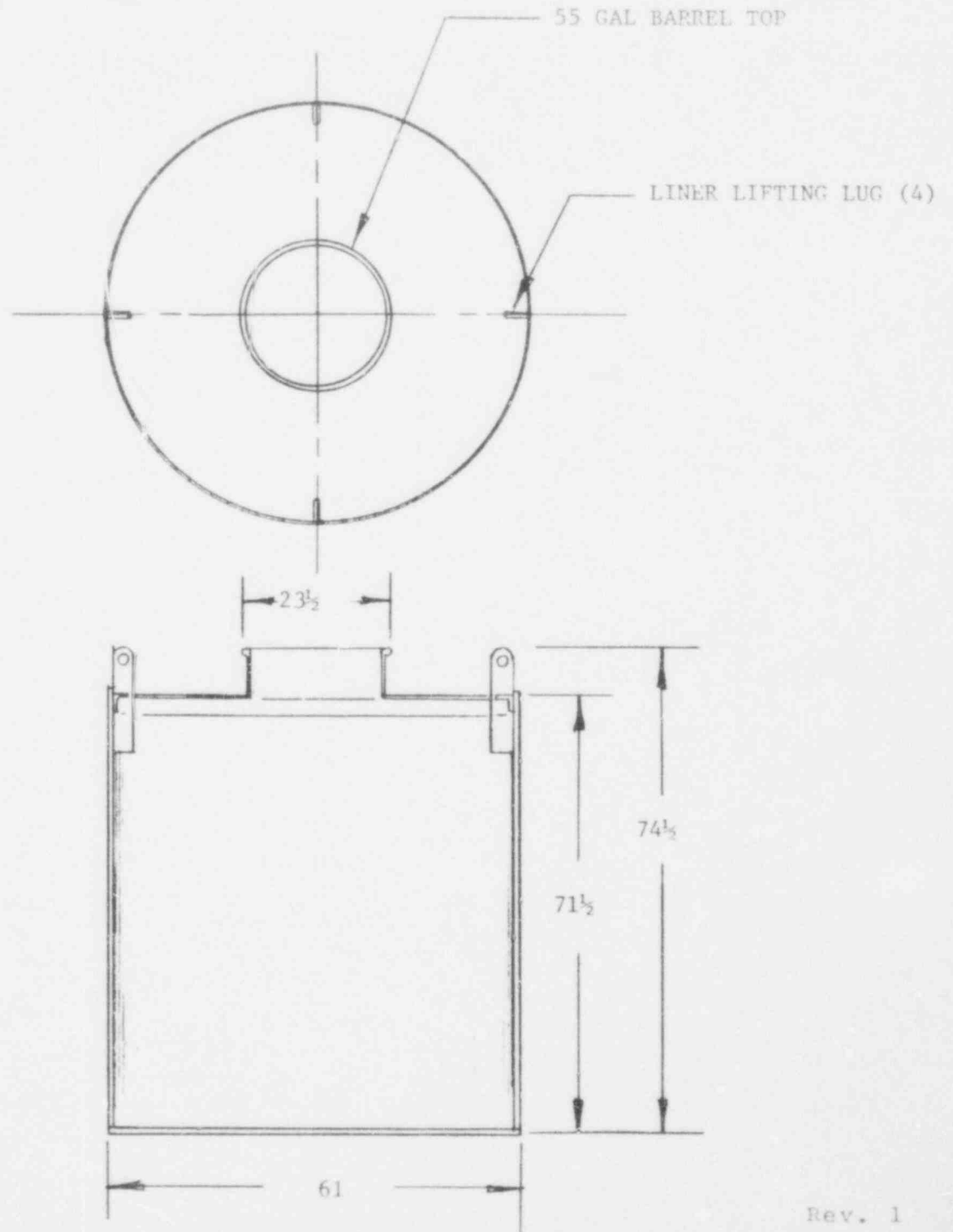


Rev. 1

LINER-SOLID WASTE

USED ON CASK LL-50-100 (CNS 8-120)

CAPACITY 121 CU. FT.



701 208

MANUAL UNLOAD PENETRATION  
ON THIS END

REMOVABLE COVER

EXTERNAL  
ROLLER  
CONVEYOR

INTERNAL  
ROLLER CONVEYOR  
SECTION

**AL-31-12D**

(CNS 12-180)

Rev. 1

701 209

CHEM-NUCLEAR SYSTEMS, INC.

TRANSPORT CASK

ATCOR AL-31-12D (CNS 12-180)

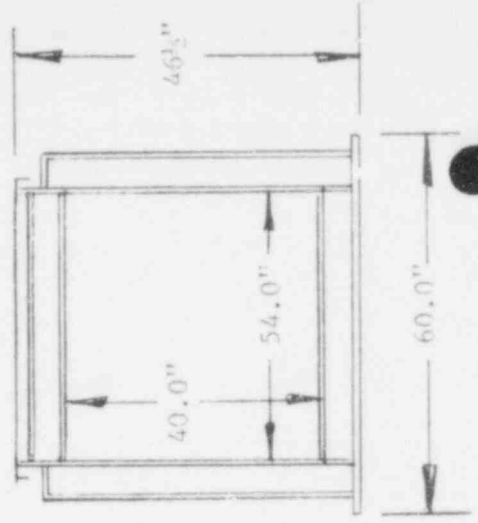
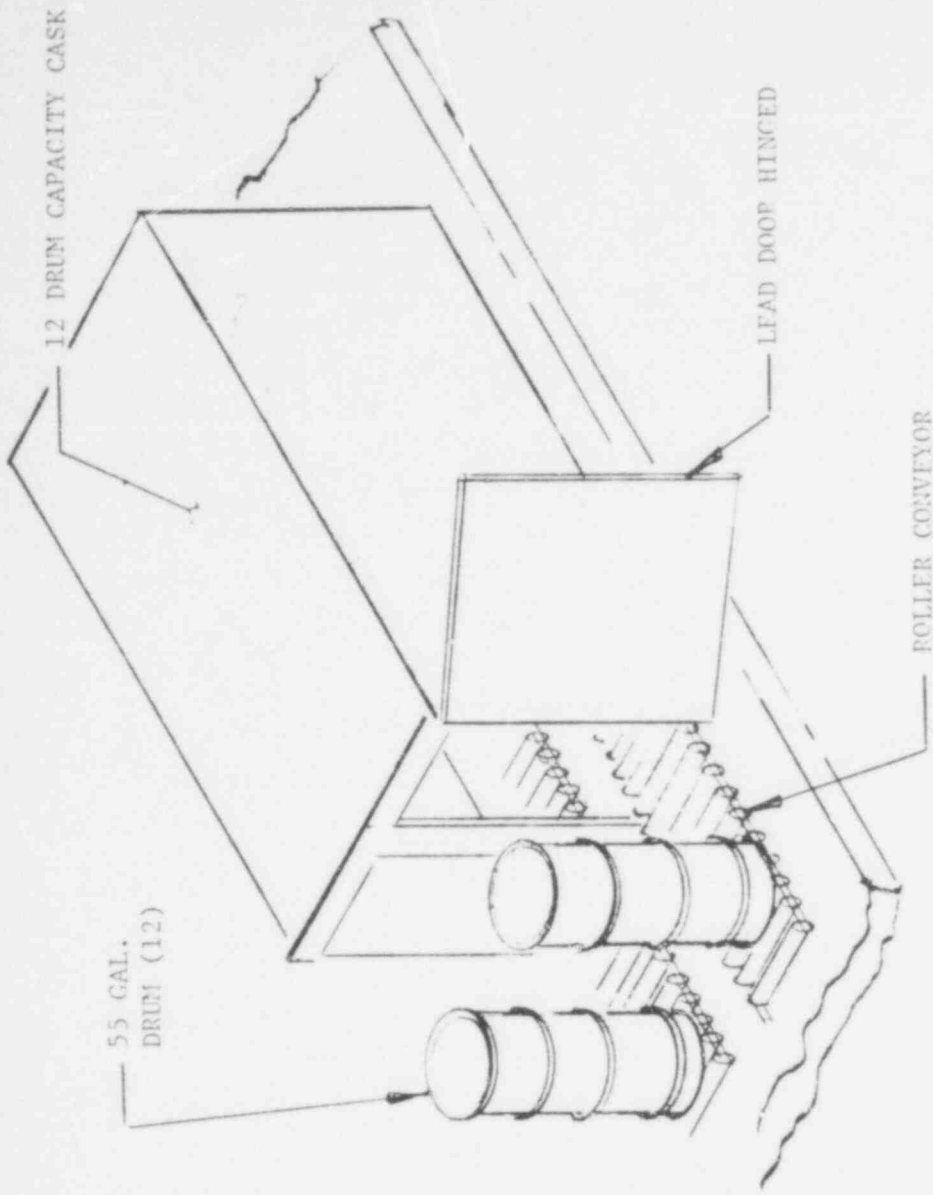
SHIELDING: 2 IN. LEAD EQUIV.

STRONG LIGHT CONTAINER

CAPACITY: (12) 55 GAL. DRUMS

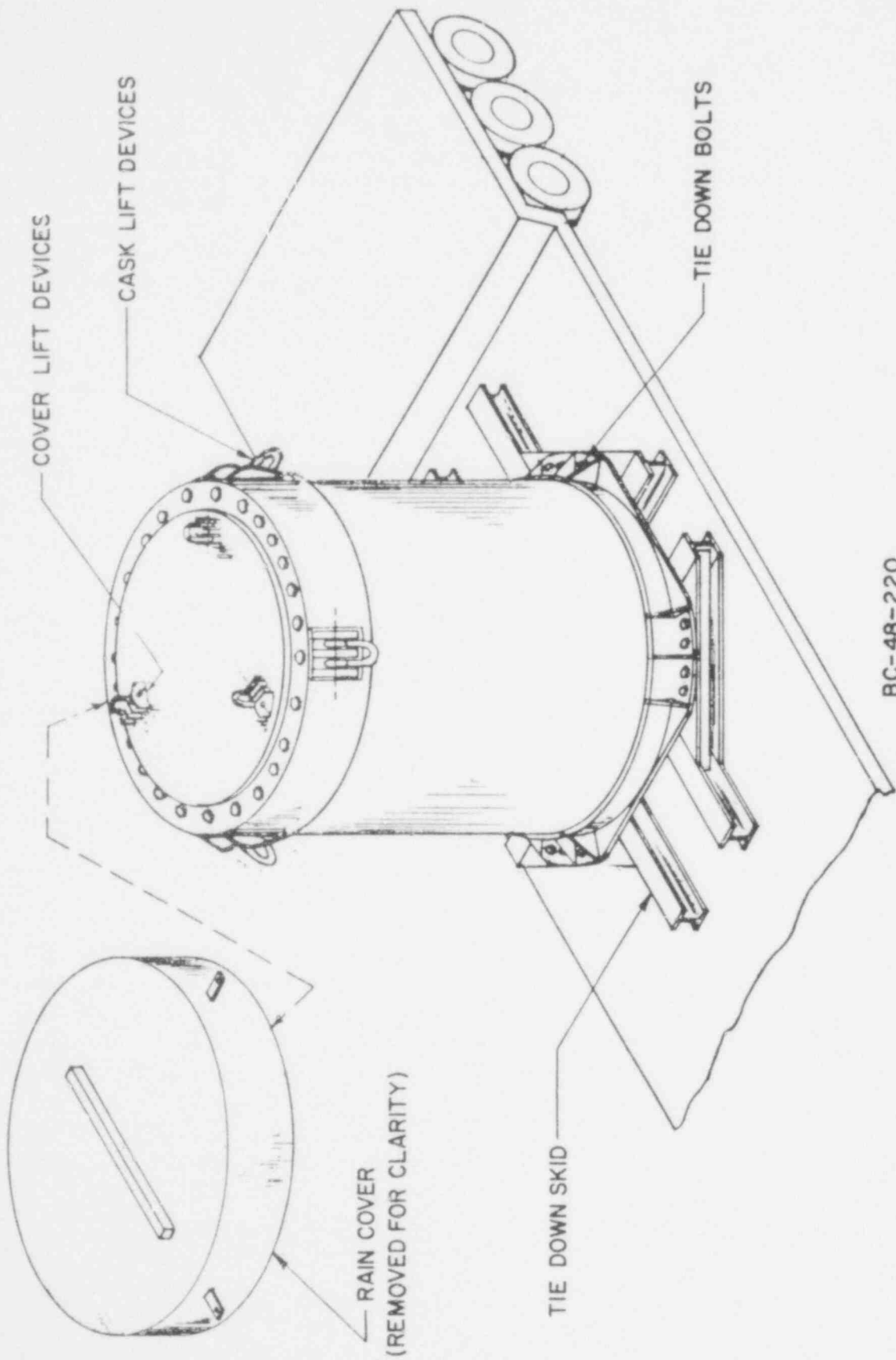
WEIGHT: GROSS WT. (EMPTY)

31,000 LBS.



Rev. 1





BC-48-220  
(CNS 14-190)

TRANSPORT CASK

ATCOR BC-48-220 (CNS 14-190)

SHIELDING: 2.75 IN. LEAD EQUIV.

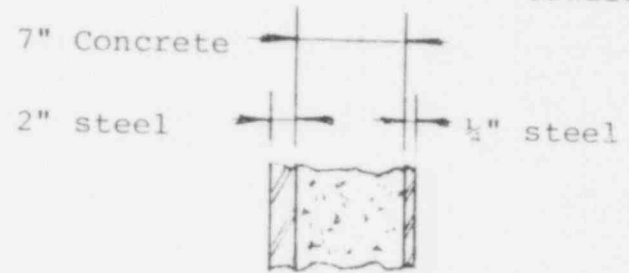
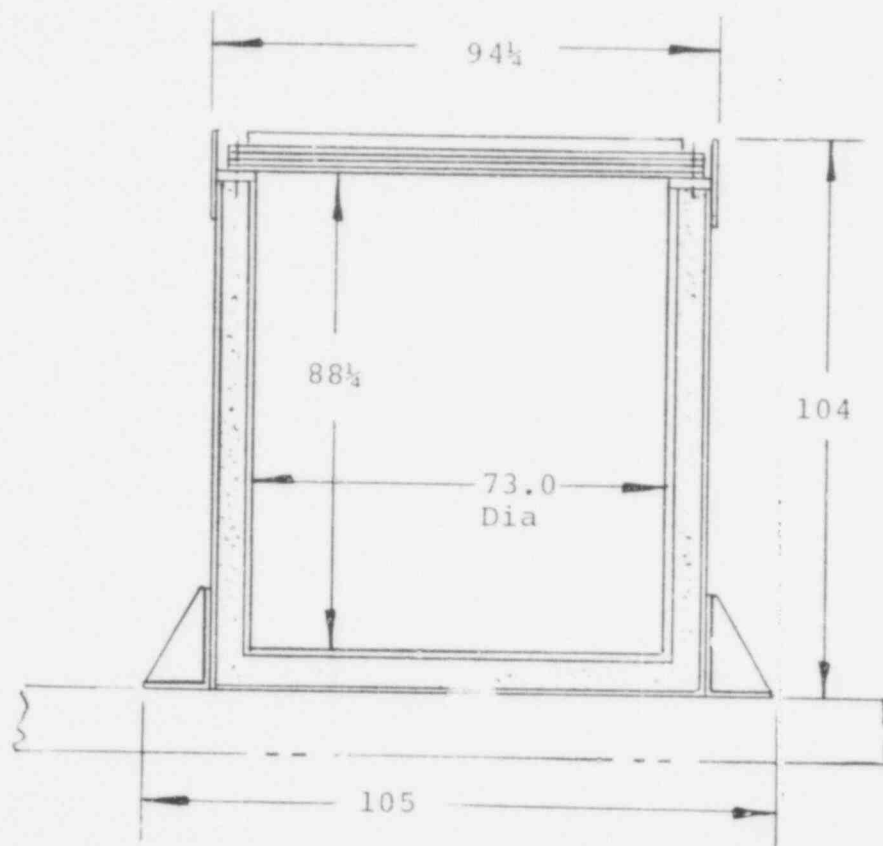
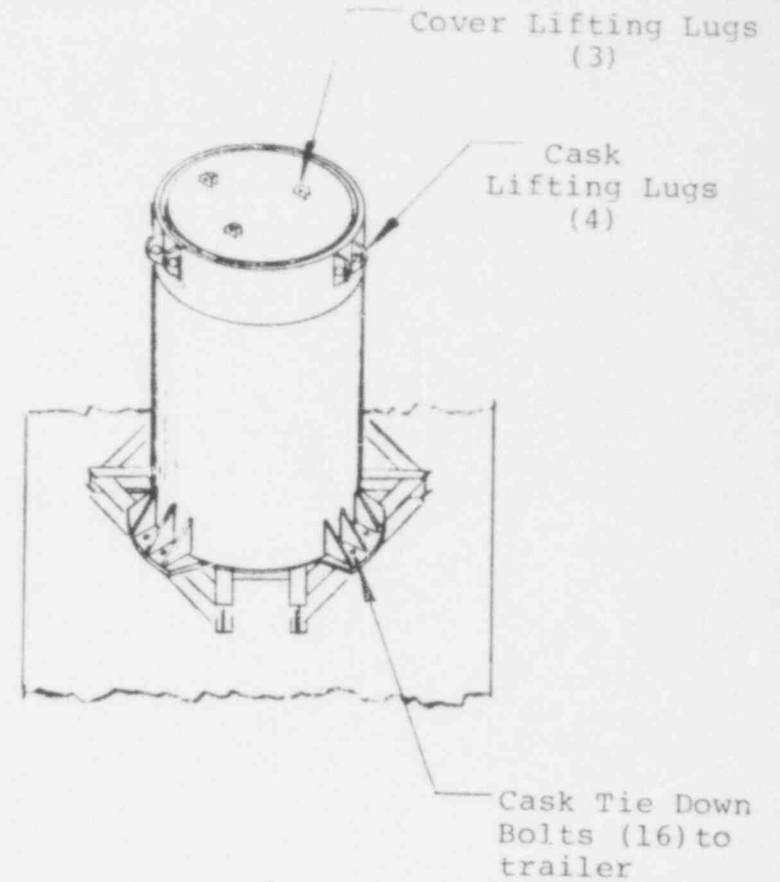
TYPE B - USA/5026/B

CAPACITY: (14) 55 GAL. DRUMS

OR (1) 195 CU. FT. CONTAINER

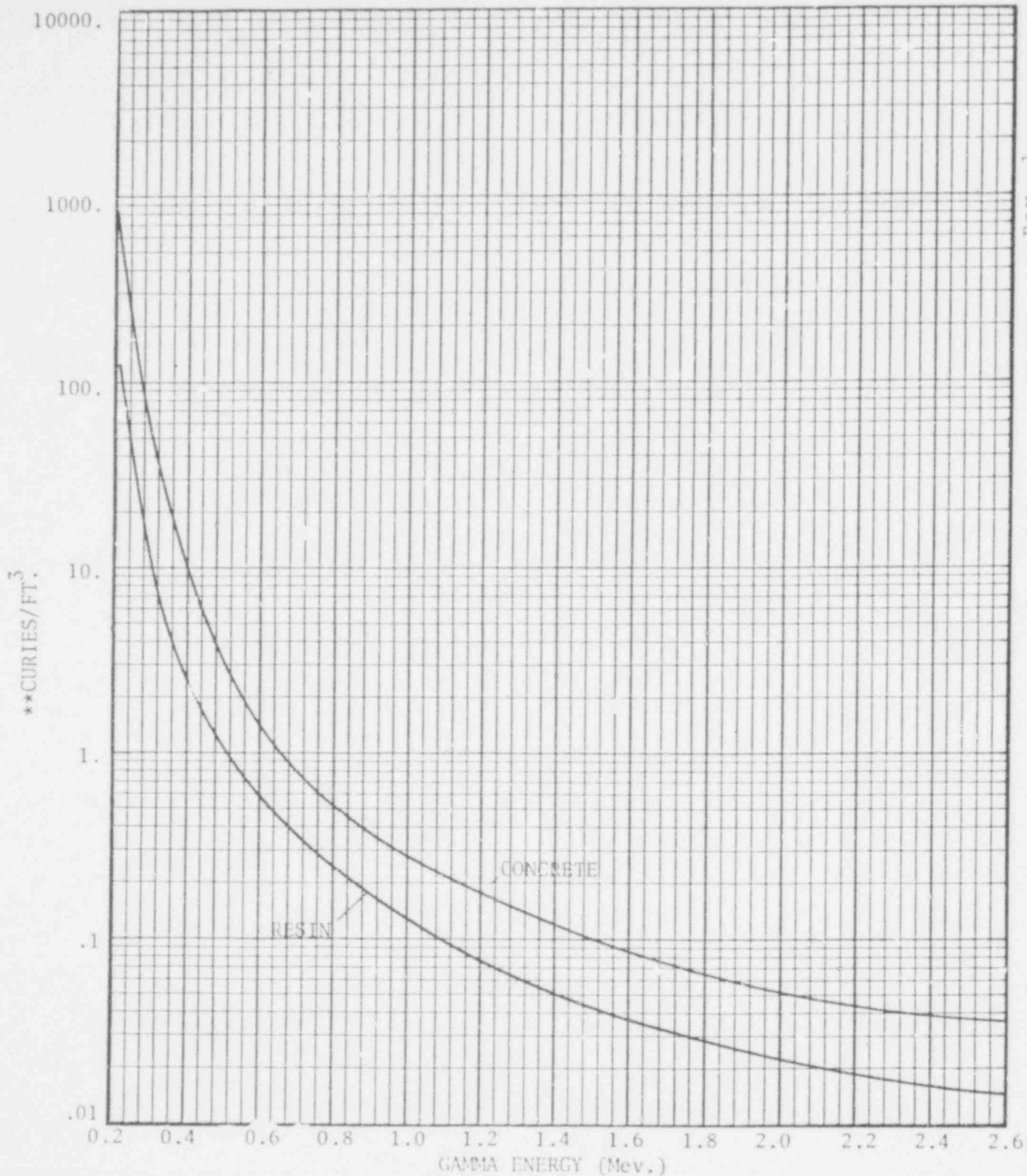
WEIGHT: GROSS WT. (EMPTY) 60,280 LBS.

CASK LID 8,300 LBS.



TYP. WALL SECTION

701 212



\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

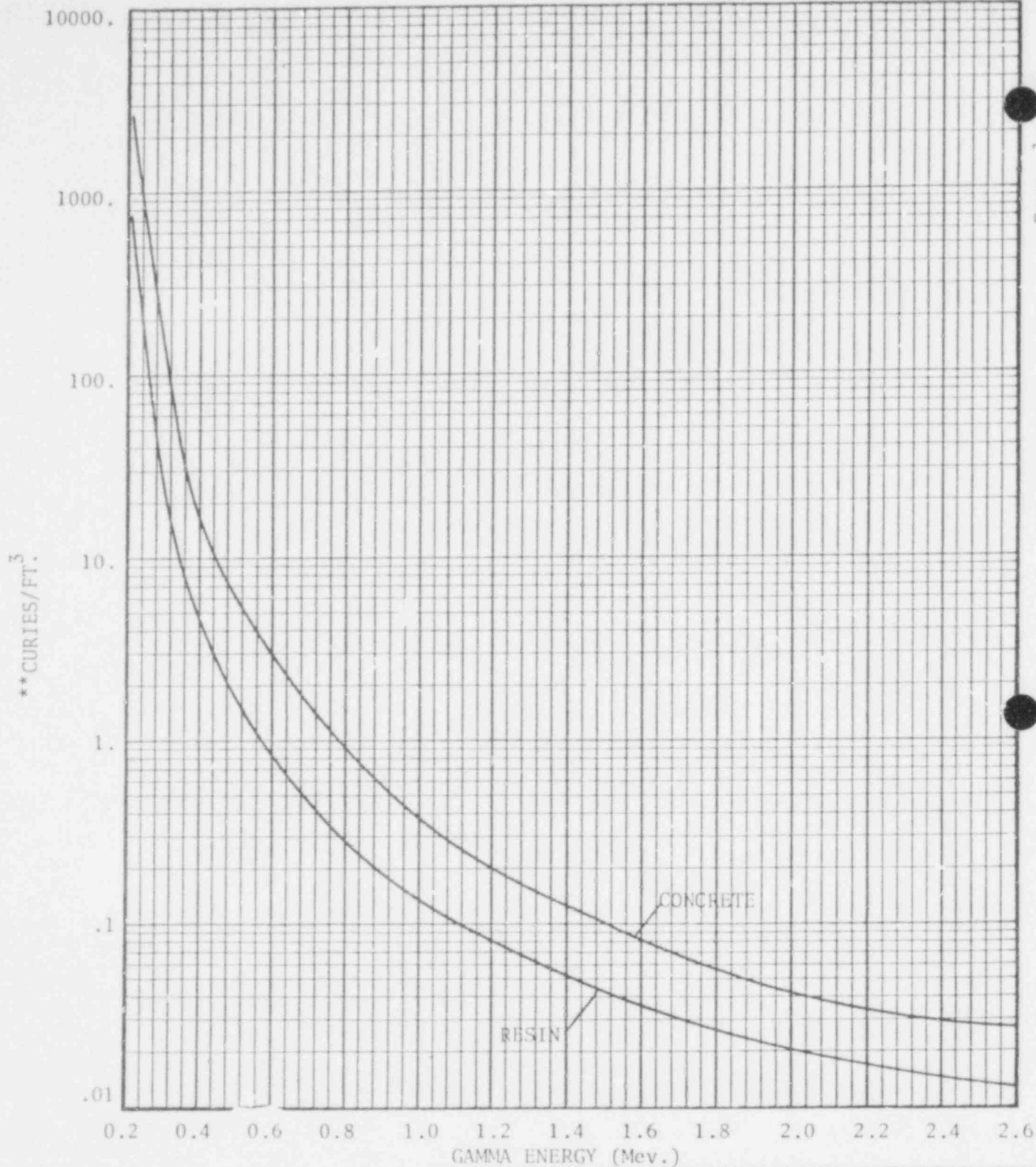
CASK: CNS 14-190  
(CASK EC-48) 1/4 INCH STEEL, 7 INCHES CONCRETE  
2-1/4 INCHES STEEL  
SHIELDING ON SIDE

701-213

REV.

DATE

SHEET



\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK: CNS 14-190  
(CASK BC-48' 4-3/4 INCHES STEEL  
SHIELDING ON TOP

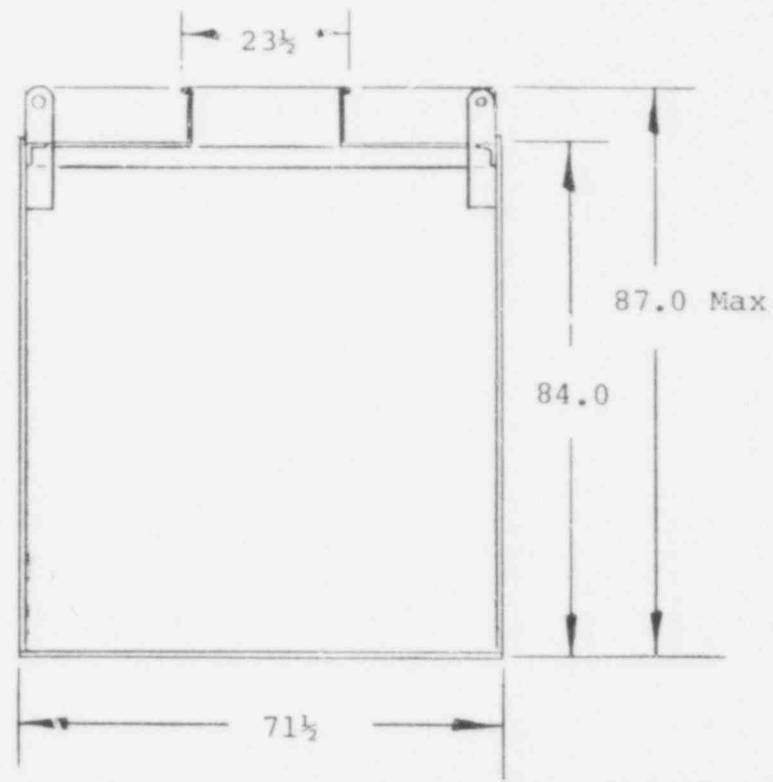
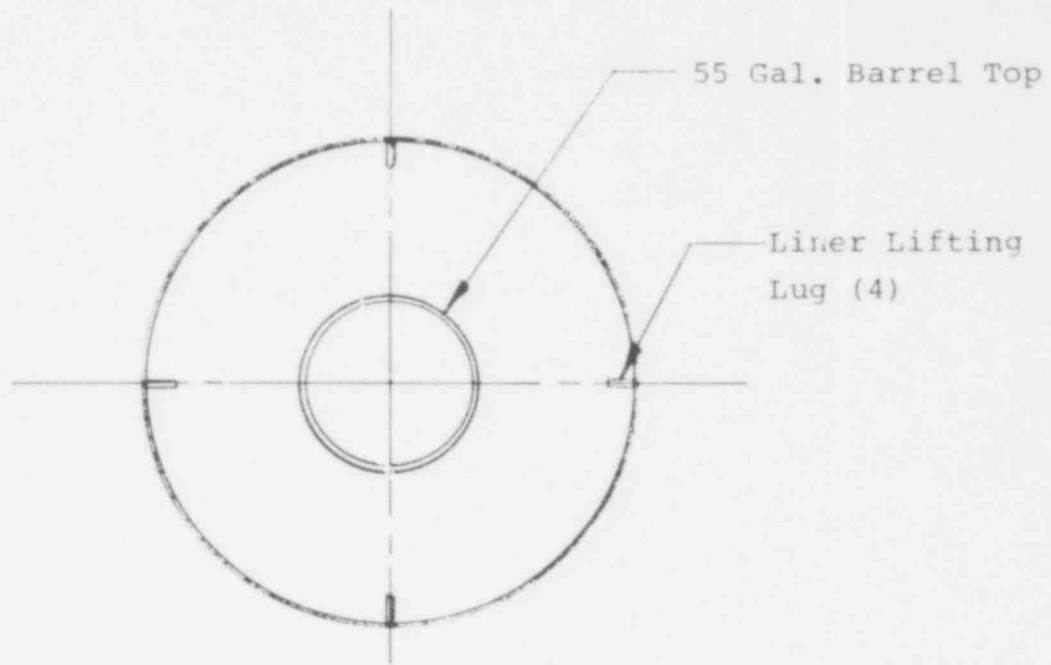
701 214

REV.

DATE

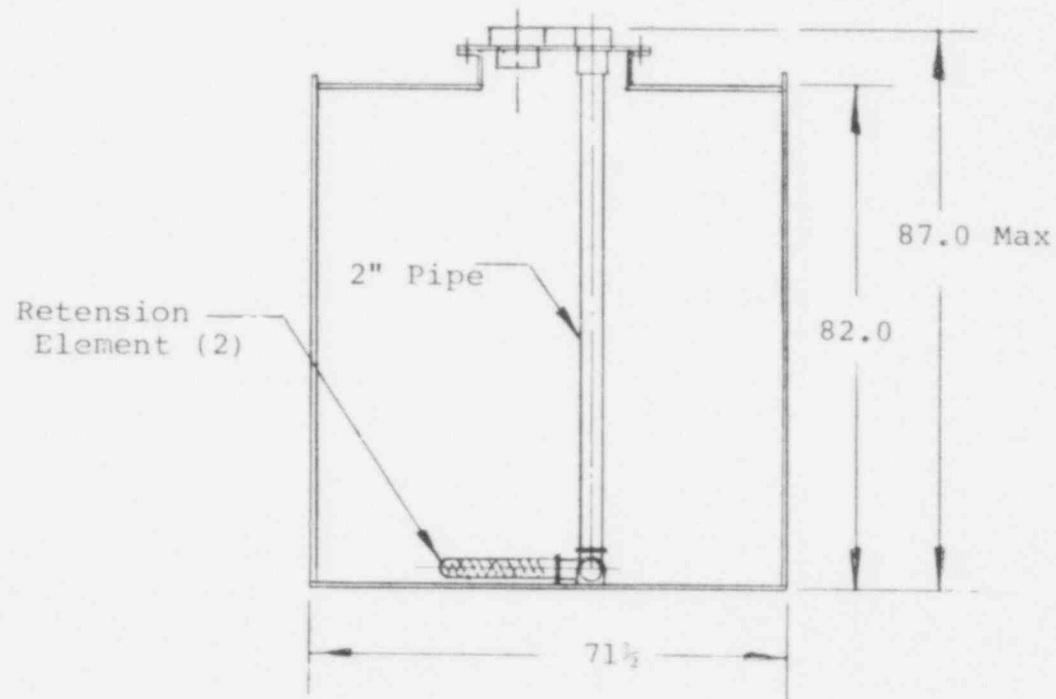
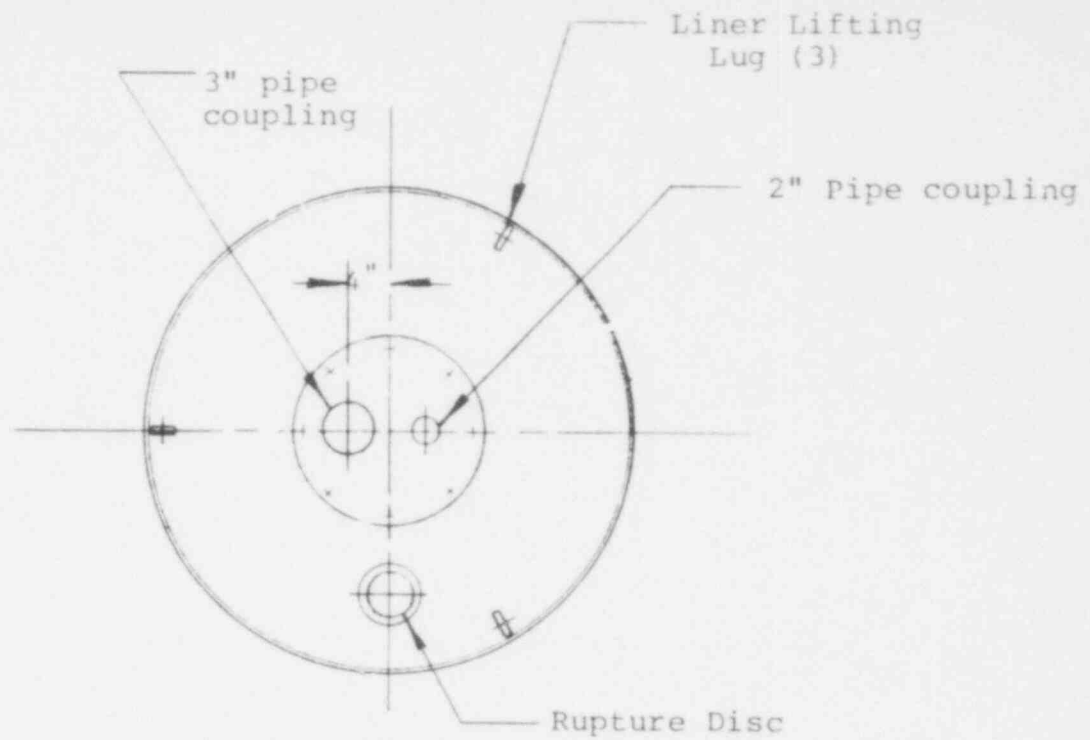
SHEET

Liner - Solid Waste  
used on Cask BC-48-220 (CNS 14-190)  
Capacity 195 cu. ft.

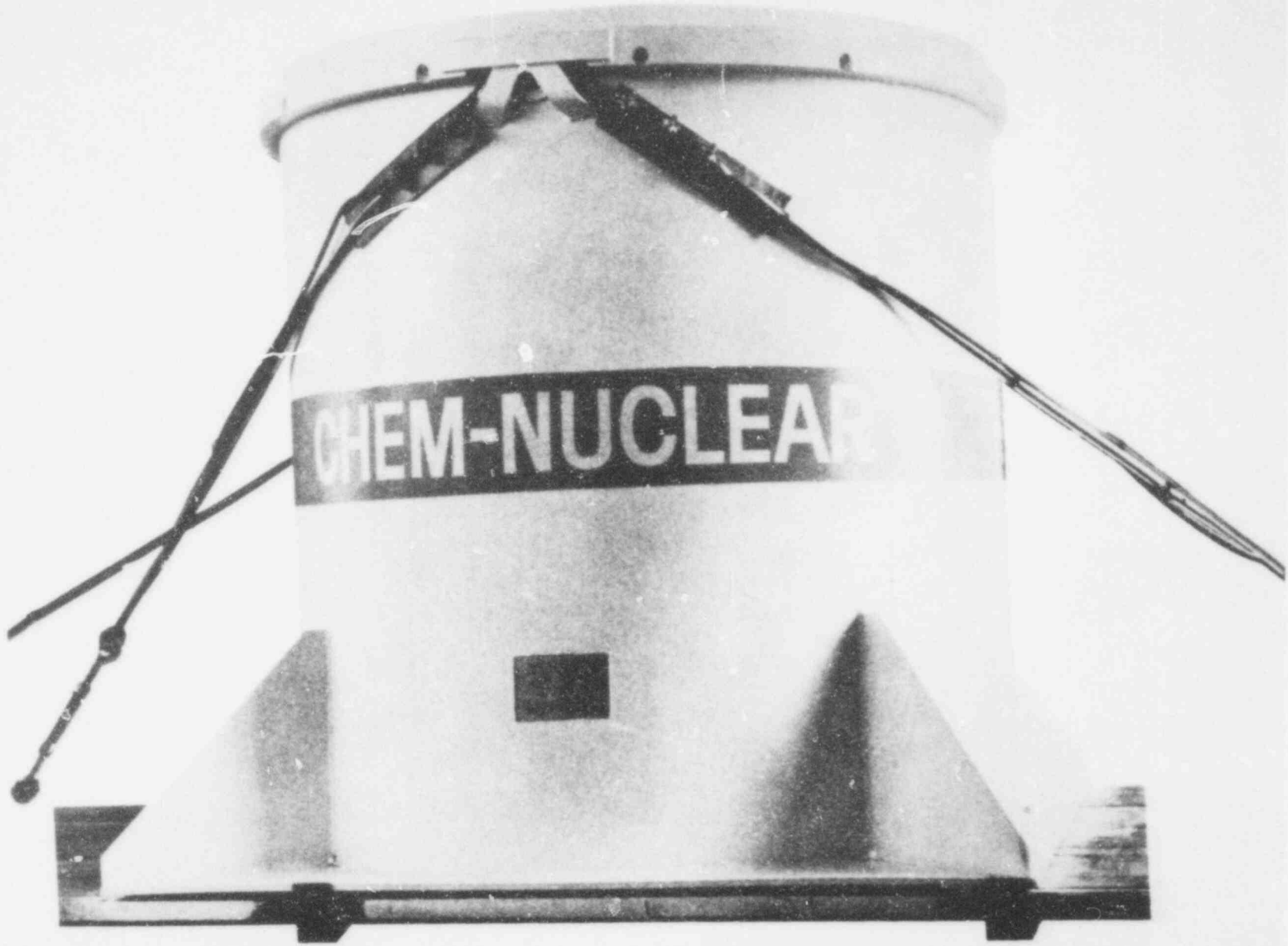


701 215

Liner - Resin  
used on Cask BC-48-220 (CNS 14-190)  
Capacity 195 cu. ft.



701 216



POOR ORIGINAL

701 217

CHEM-NUCLEAR SYSTEMS, INC.  
CNS 14-195L

Rev. 1

**CHEM-NUCLEAR SYSTEMS, INC.**

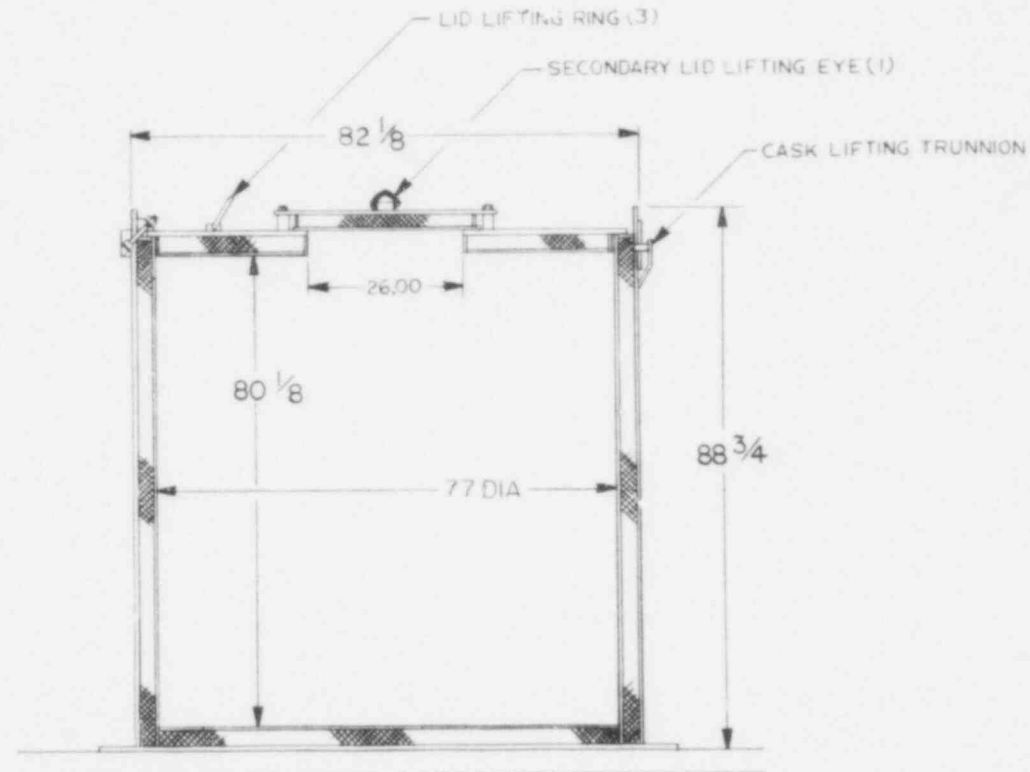
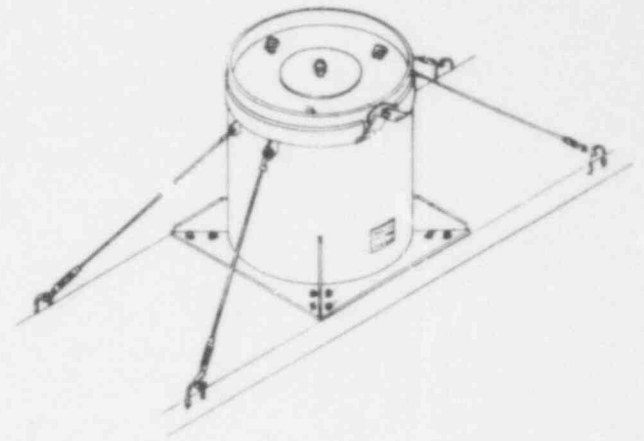
TRANSPORT CASK  
C.N.S. 14-195L  
SHIELDING: 2.00 IN. LEAD EQUIV.

CAPACITY

(14) 55 GAL. DRUMS  
OR (1) 200 CU. FT. CONTAINER

WEIGHT

GROSS WT. (EMPTY) 31,550 LBS.  
CASK LID 2,650 LBS.  
SECONDARY LID 450 LBS.

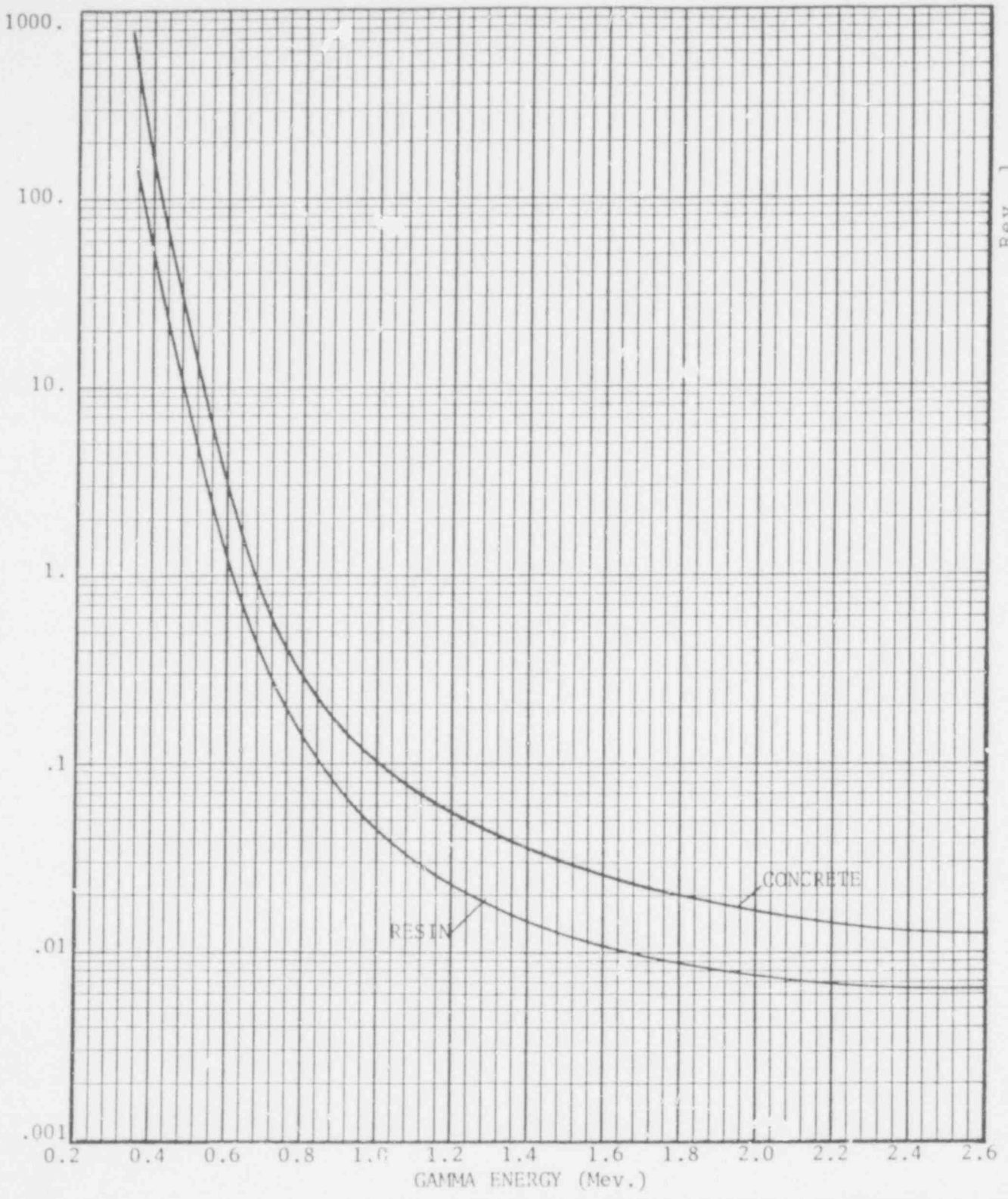


REV.1

701 218



\*\*CURIES/FT<sup>3</sup>



\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET FROM CASK IS 10 MR/HR

### CHEM - NUCLEAR SYSTEMS, INC.

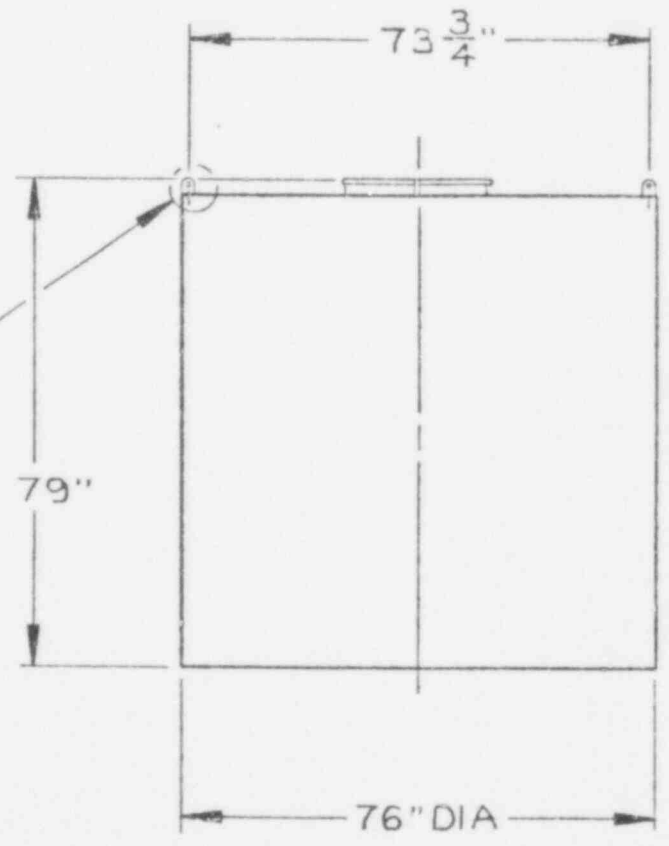
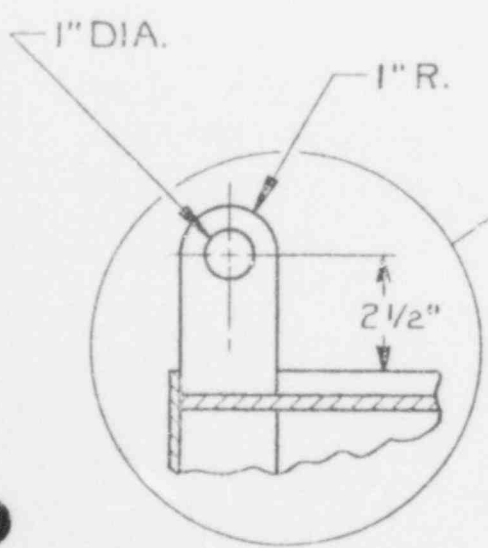
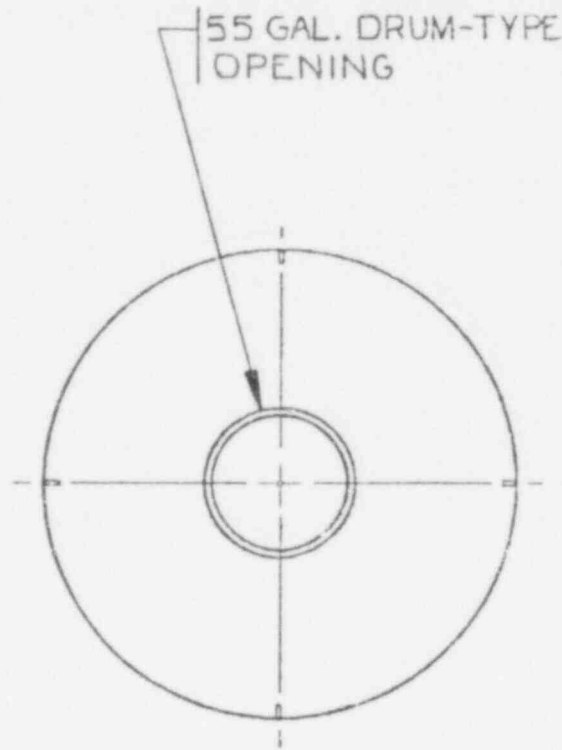
CASK 14-195-L 3/4 INCH STEEL,  
1-5/8 INCHES LEAD,  
1/4 INCH STEEL

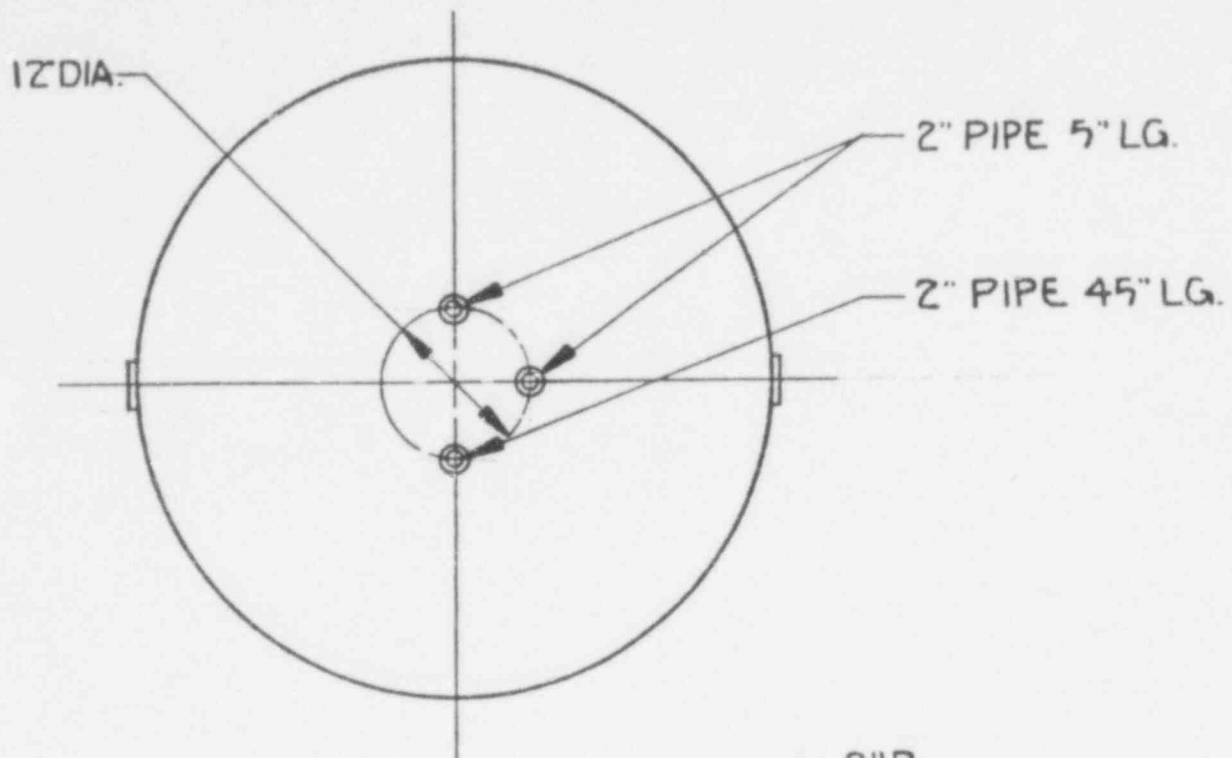
701 219

REV.	DATE	SHEET
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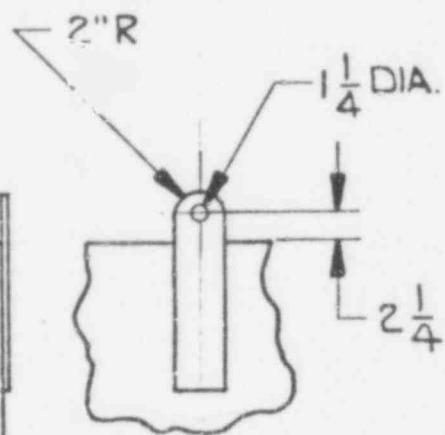
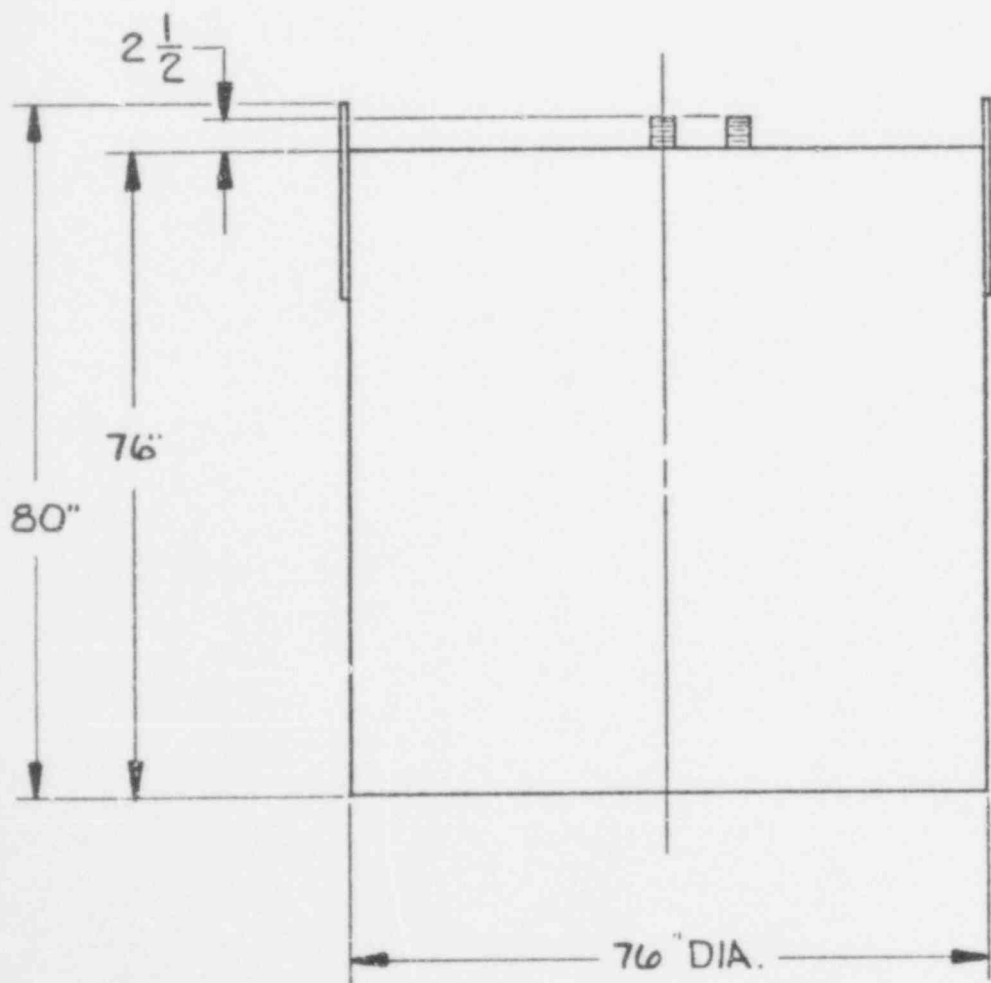
DISPOSABLE CONTAINER  
14-195 CASK  
CAPACITY... 200 CU. FT.  
D.O.T. SPEC. 7A

Rev. 1





Rev. 1



DISPOSABLE CONTAINER  
14-195 CASK  
CAPACITY 200 CU. FT.



CHEM-NUCLEAR

POOR ORIGINAL

701 222

CHEM-NUCLEAR SYSTEMS, INC.  
CNS 14-195H Rev. 1

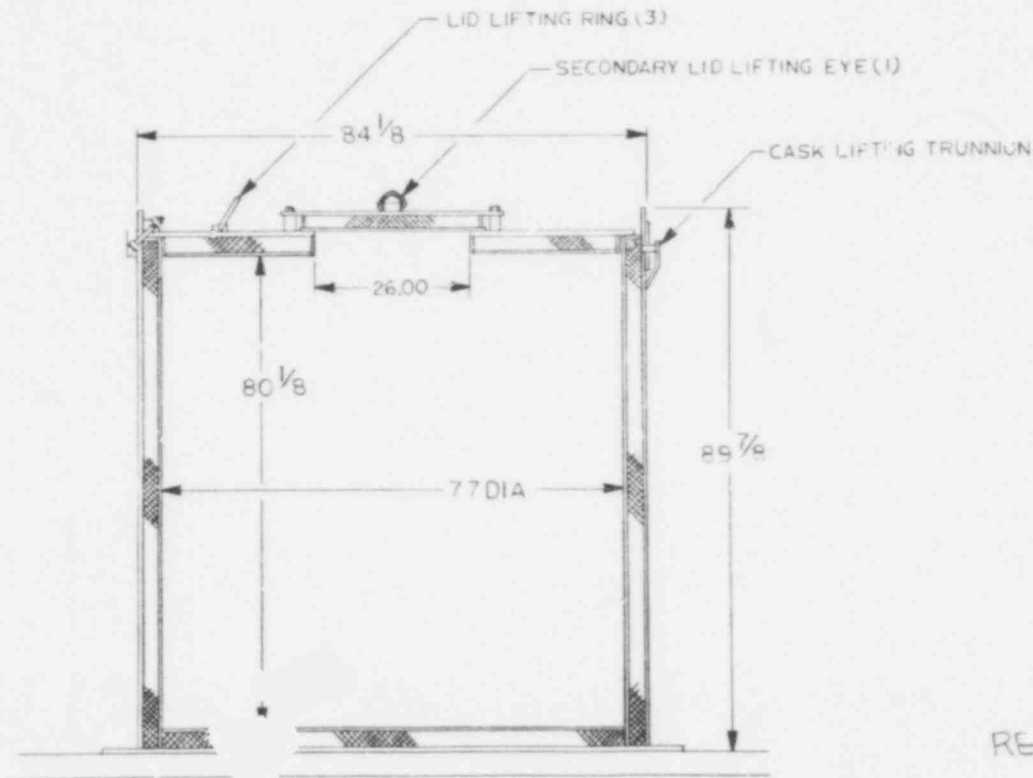
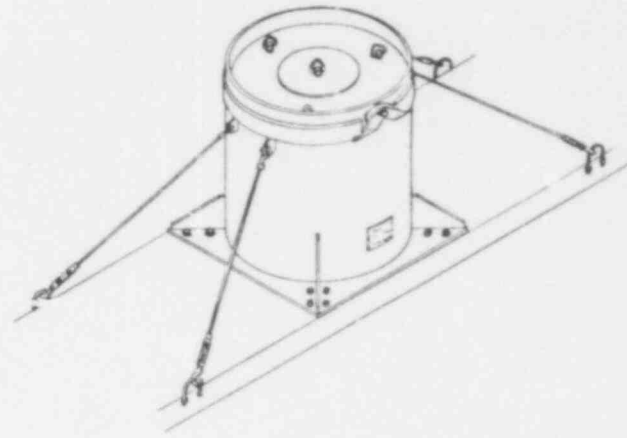
**CHEM-NUCLEAR SYSTEMS, INC.**

TRANSPORT CASK  
CNS. 14-195-H  
SHIELDING 2.75 IN. LEAD EQUIV.  
USA DOT SPEC. 7A, TYPE A  
U.S.N.R.C. PACKAGE IDENT. NO. USA/9094/A  
CAPACITY

(14) 55 GAL. DRUMS  
OR (1) 200 CU. FT. CONTAINER

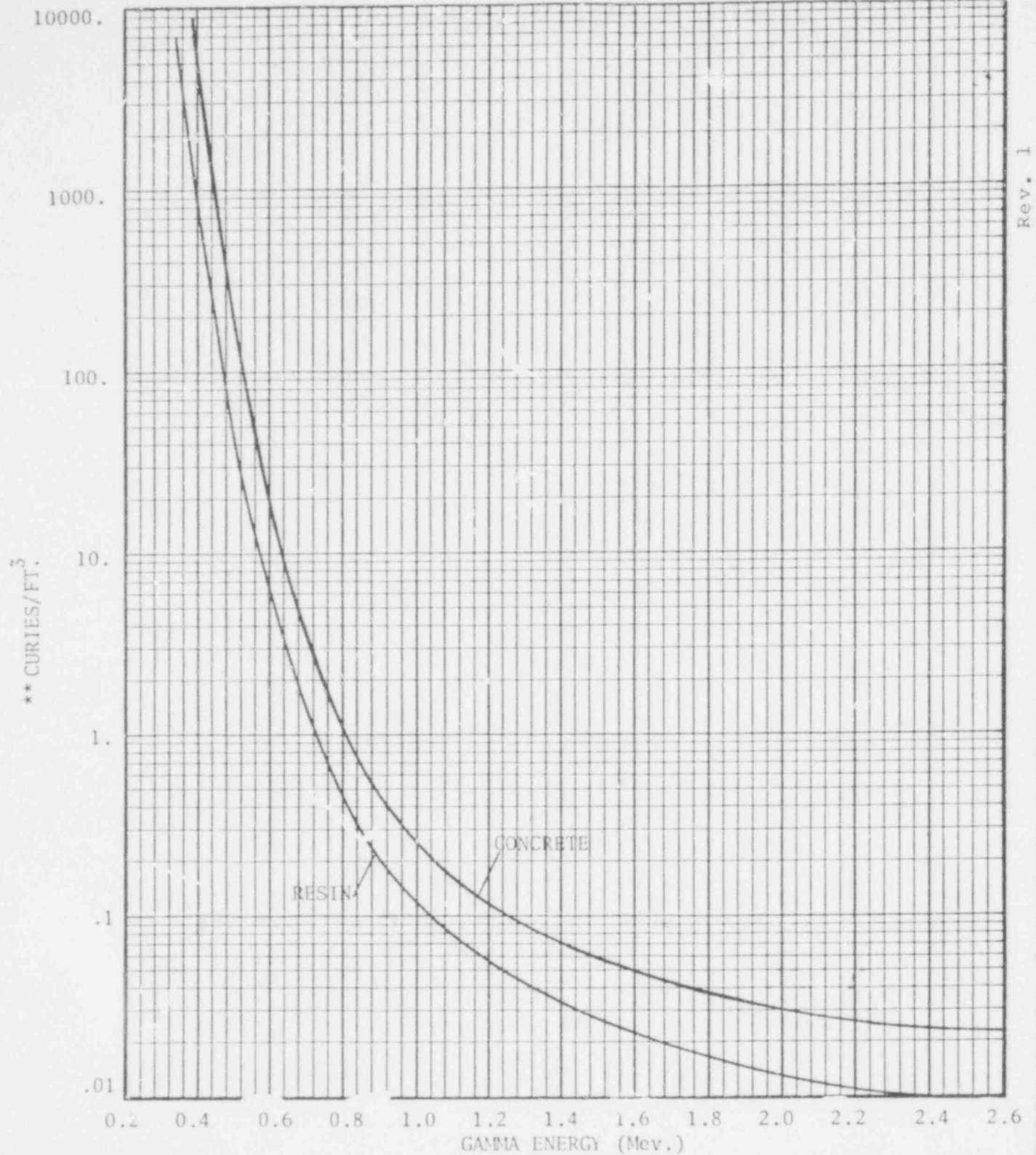
WEIGHT

GROSS WT. (EMPTY) 39,650 LBS.  
CASK LID 5,450 LBS.  
SECONDARY LID 850 LBS.



REV. 1

701  
223



\*\*BASED ON HOMOGENEOUS MIX  
DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

CASK 14-195-H 3/4 INCH STEEL,  
2-7/16 INCHES LEAD,  
1/8 INCH STEEL

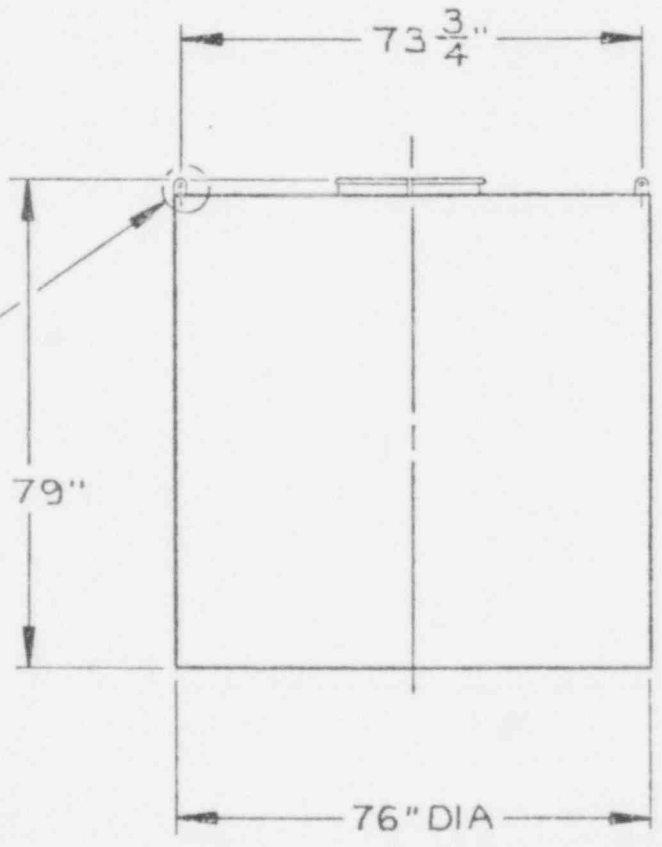
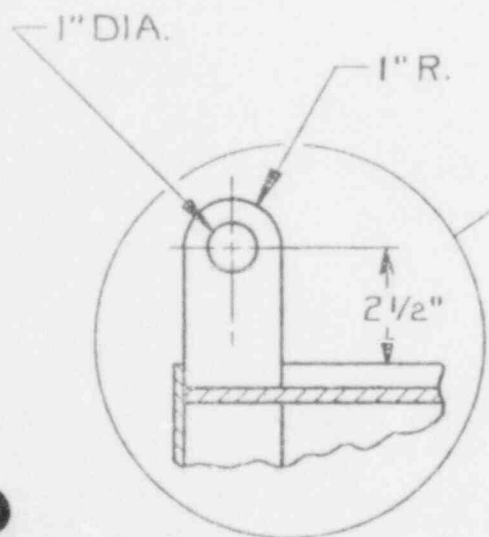
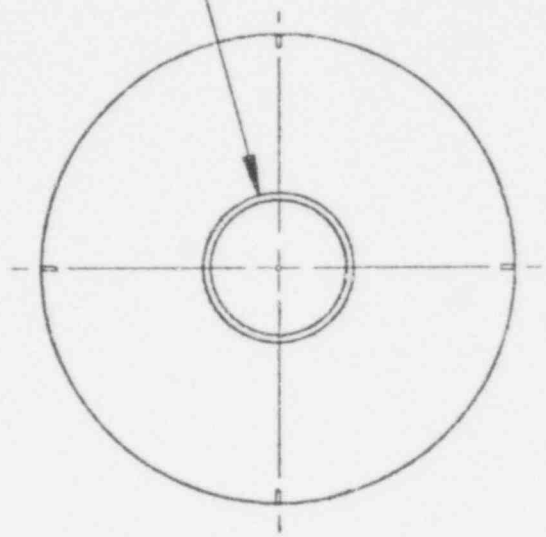
701 224

REV.	DATE	SHEET
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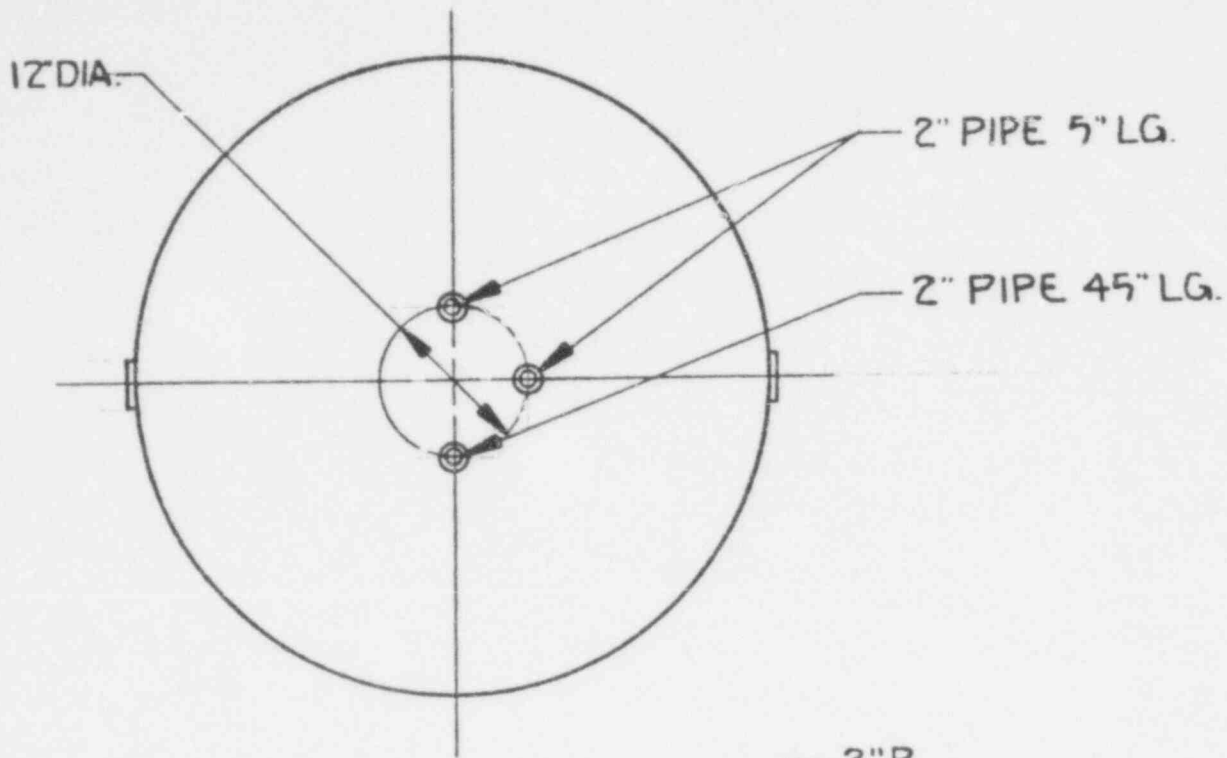
DISPOSABLE CONTAINER  
14-195 CASK  
CAPACITY... ~~200~~ CU.FT.  
D.O.T. SPEC. 7A

Rev. 1

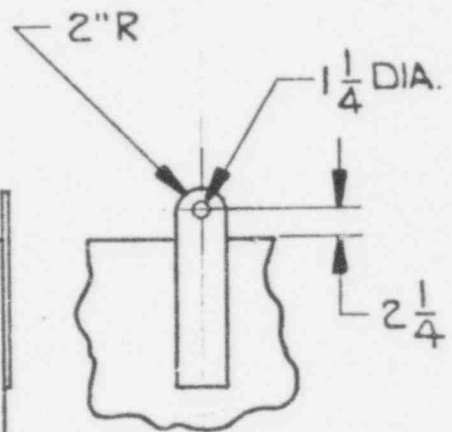
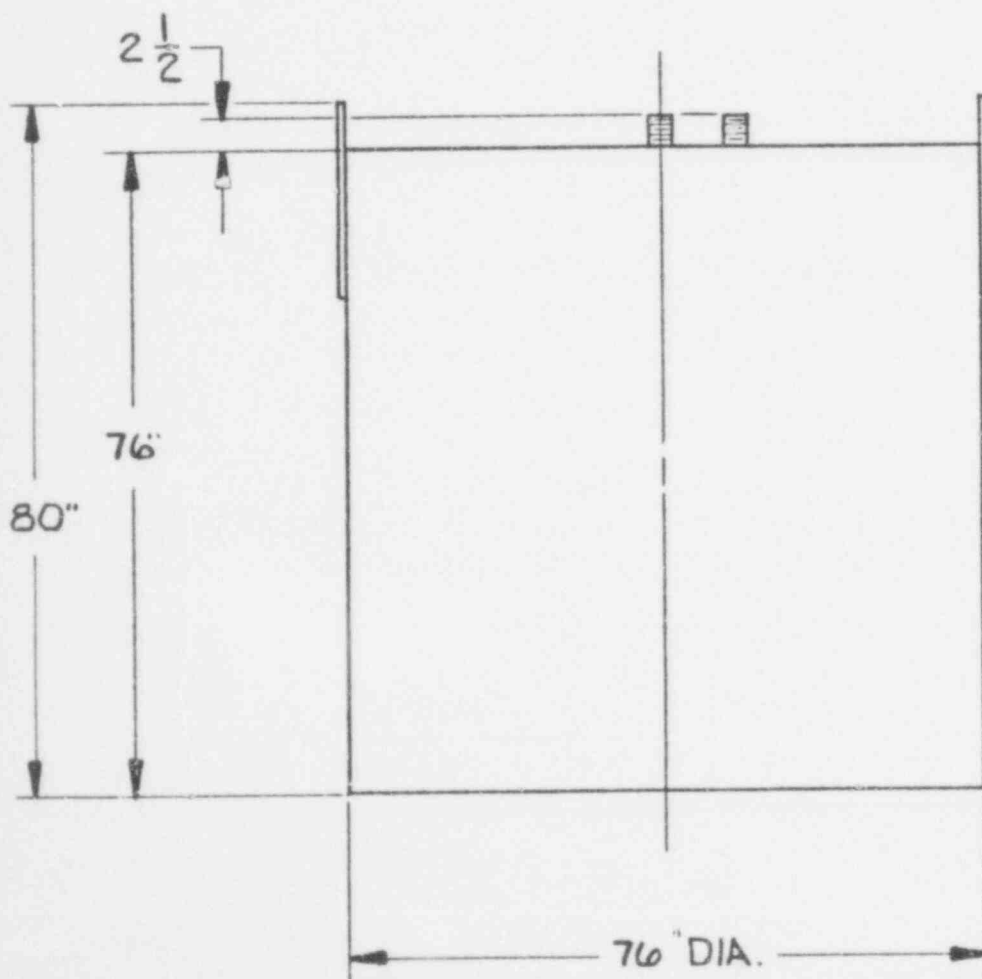
55 GAL. DRUM-TYPE  
OPENING



701 225

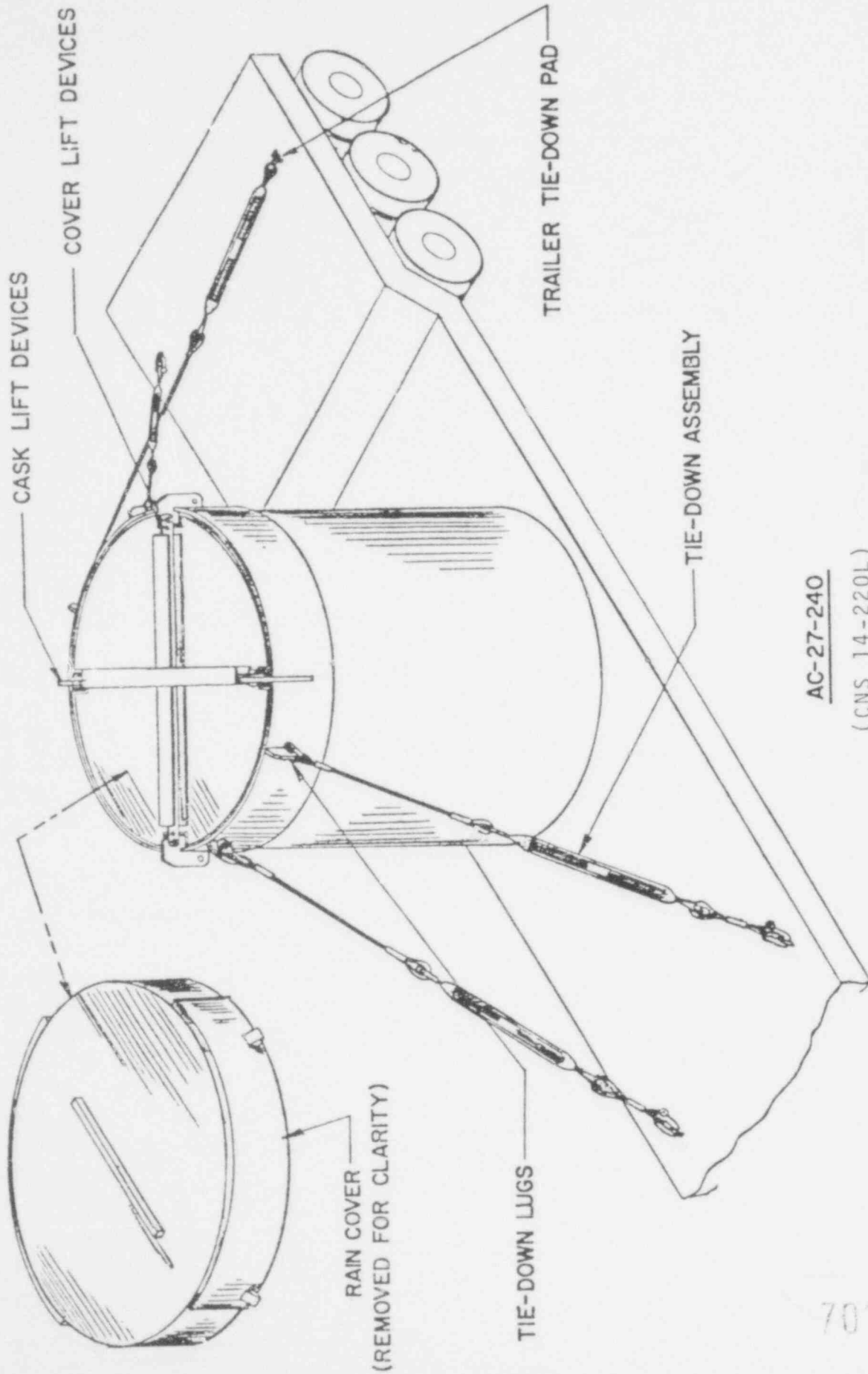


Rev. 1



DISPOSABLE CONTAINER  
14-195 CASK  
CAPACITY 200 CU. FT.





AC-27-240  
 (CNS 14-220L)

TRANSPORT CASK

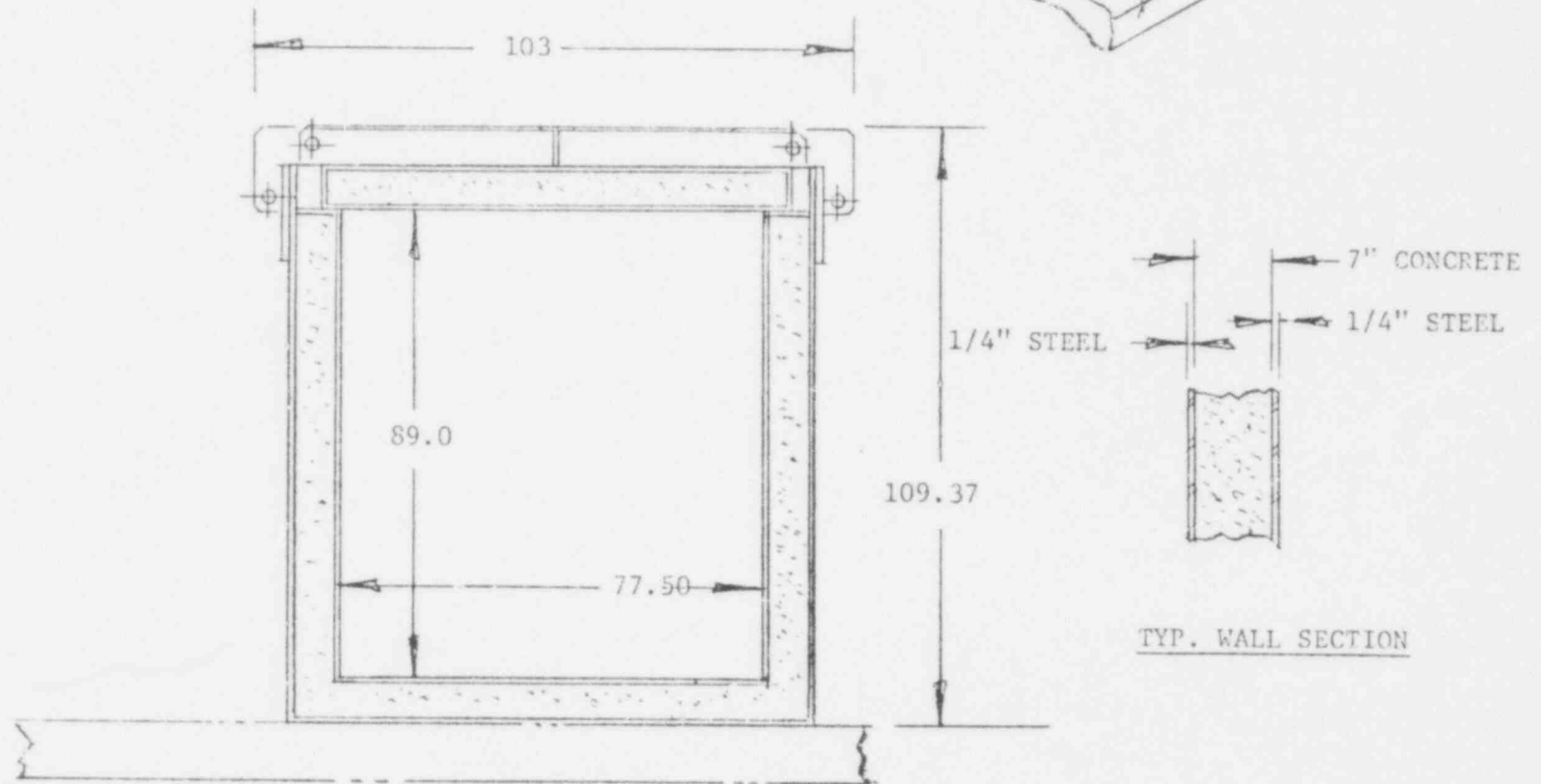
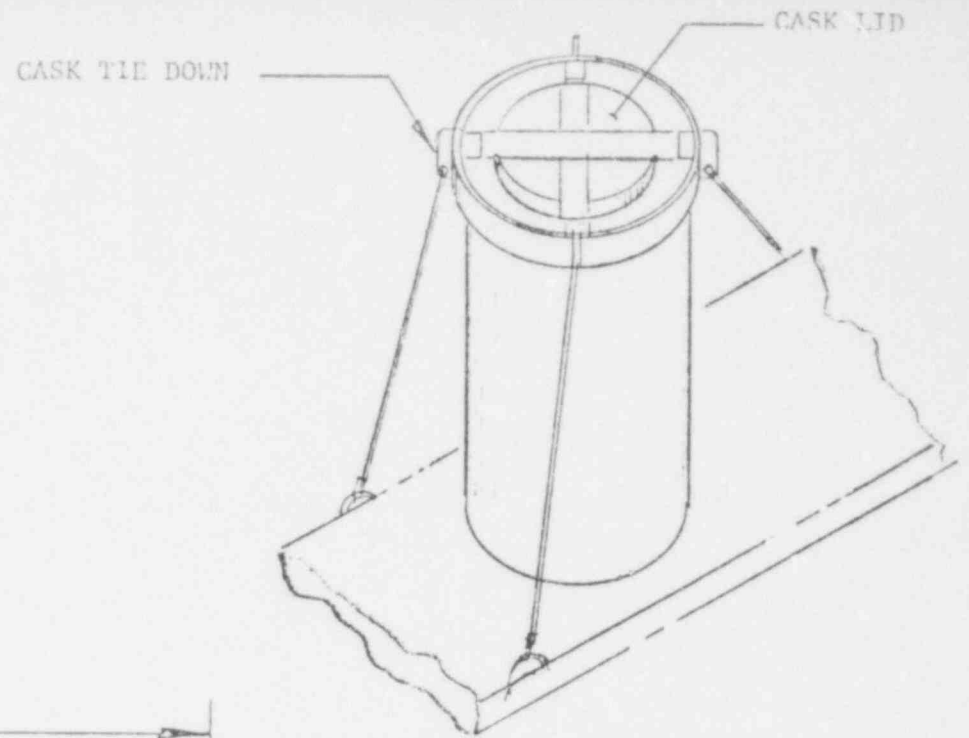
ATCOR AC-27-240 (CNS 14-220L)

SHIELDING: 1-3/4 IN. LEAD EQUIV.

CAPACITY: (14) 55 GAL. DRUMS OR  
(1) 200 CU. FT. CONTAINER

WEIGHT: GROSS WT. (EMPTY)  
33,200 LBS.

STRONG TYPE CONTAINER

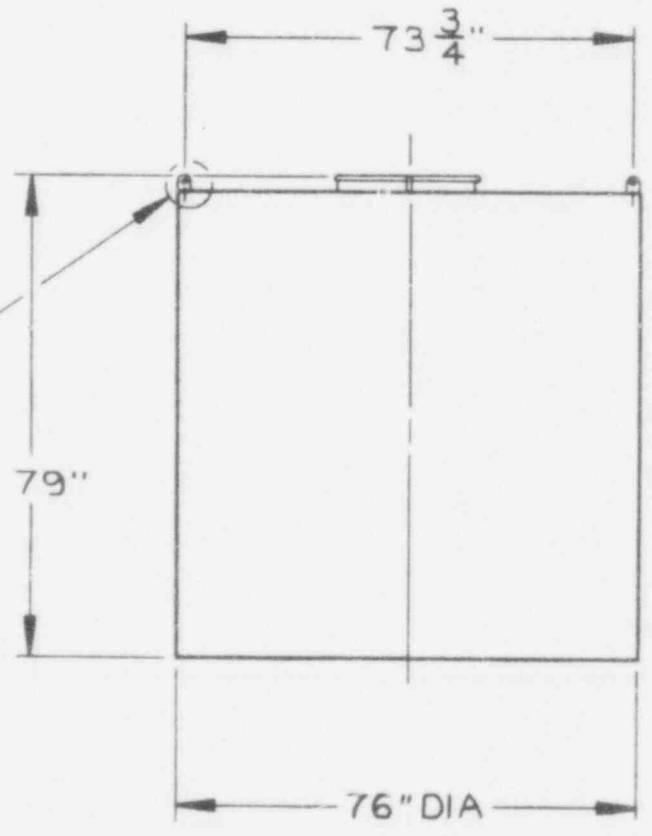
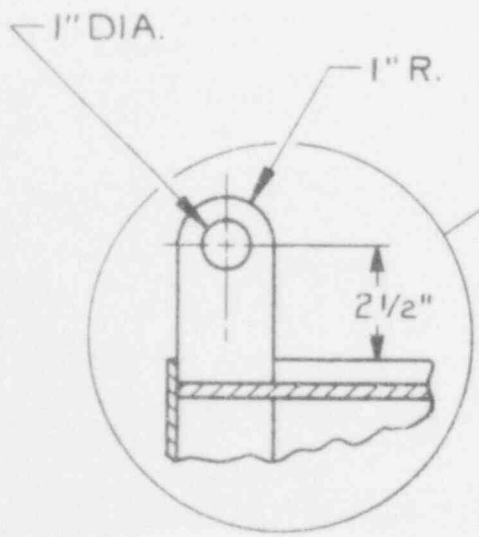
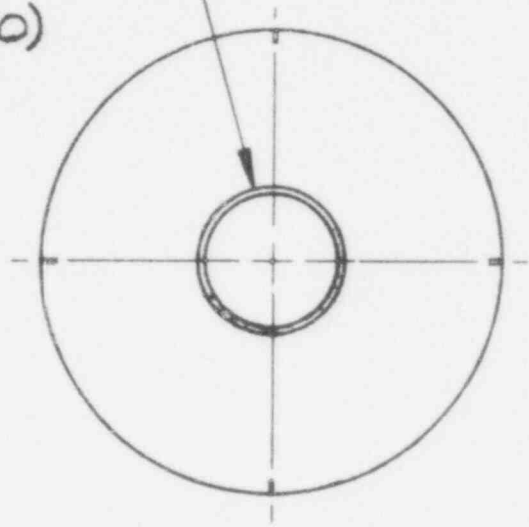


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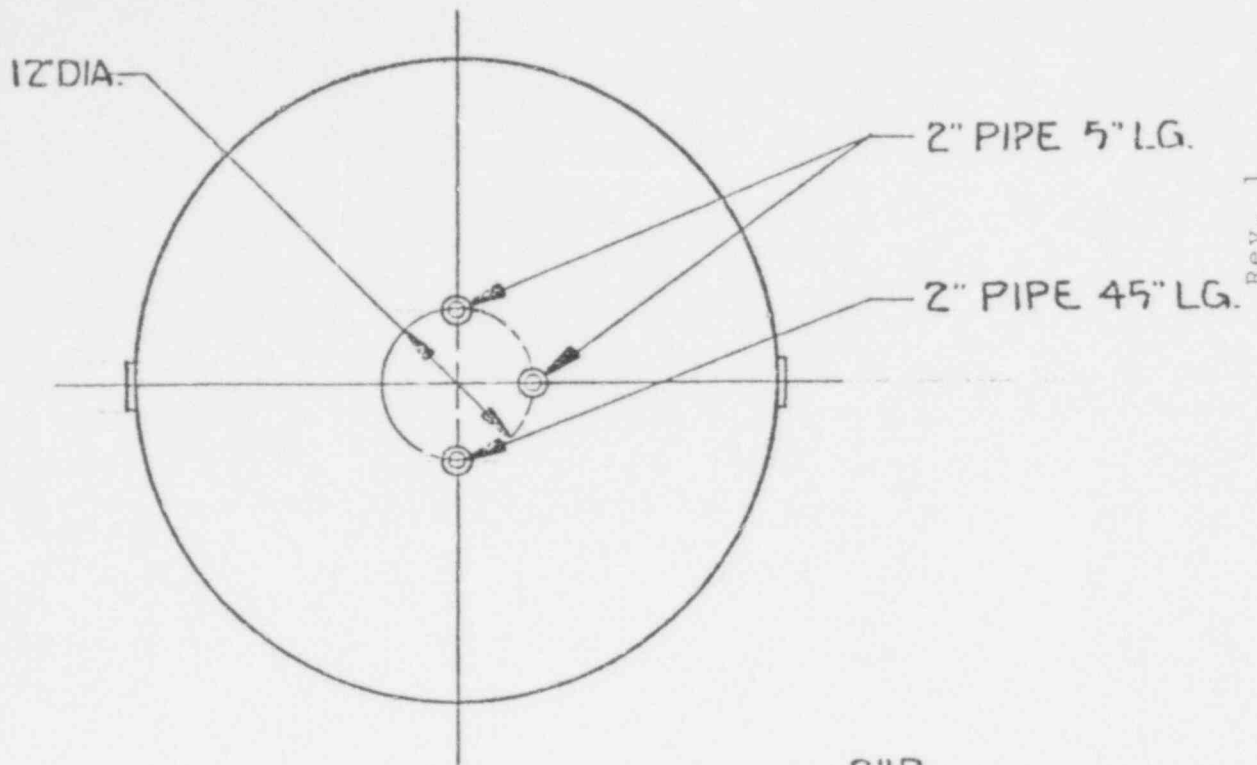
DISPOSABLE CONTAINER  
CASK-AC-27-240L(CNS 14-220)  
CAPACITY...200 CU.FT.  
D.O.T. SPEC. 7A

Rev. 1

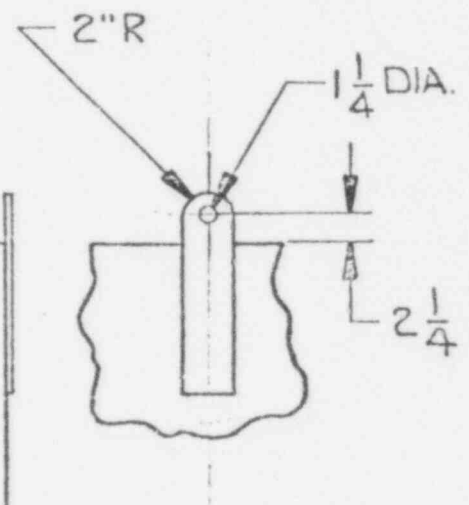
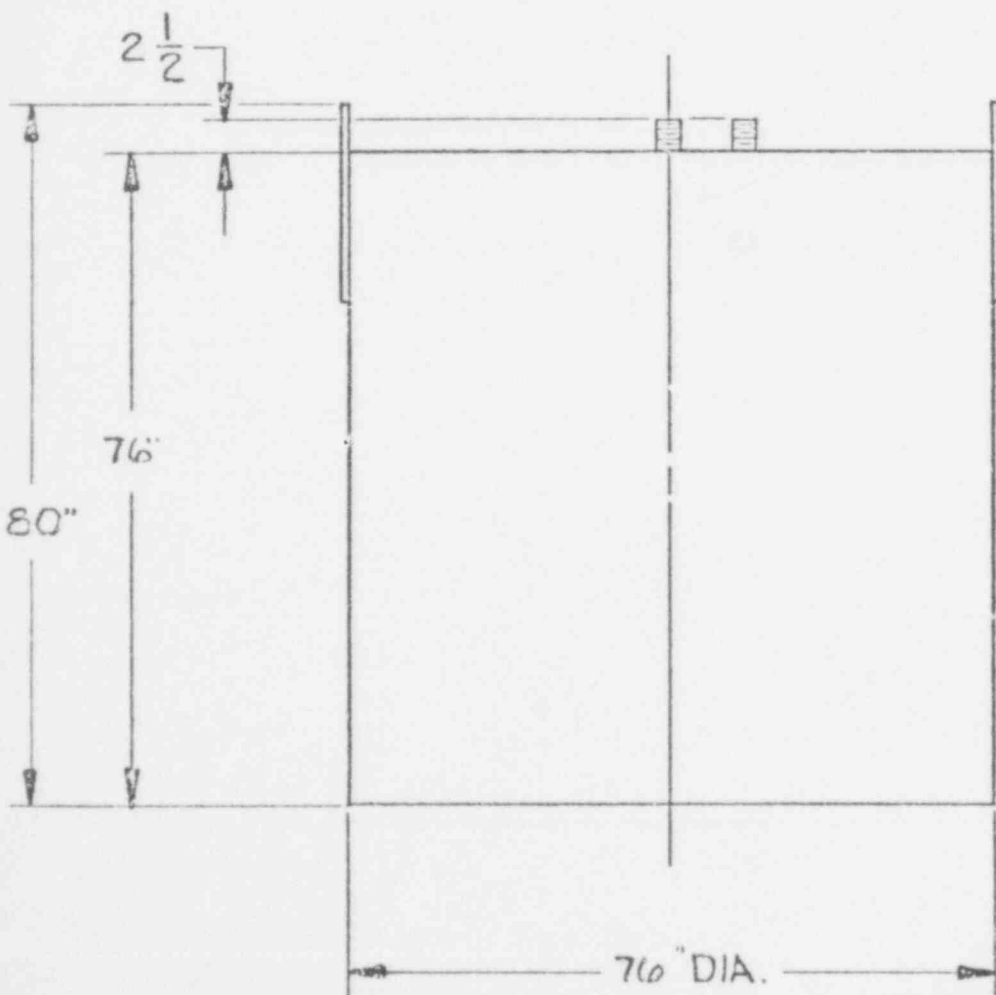
55 GAL. DRUM-TYPE  
OPENING



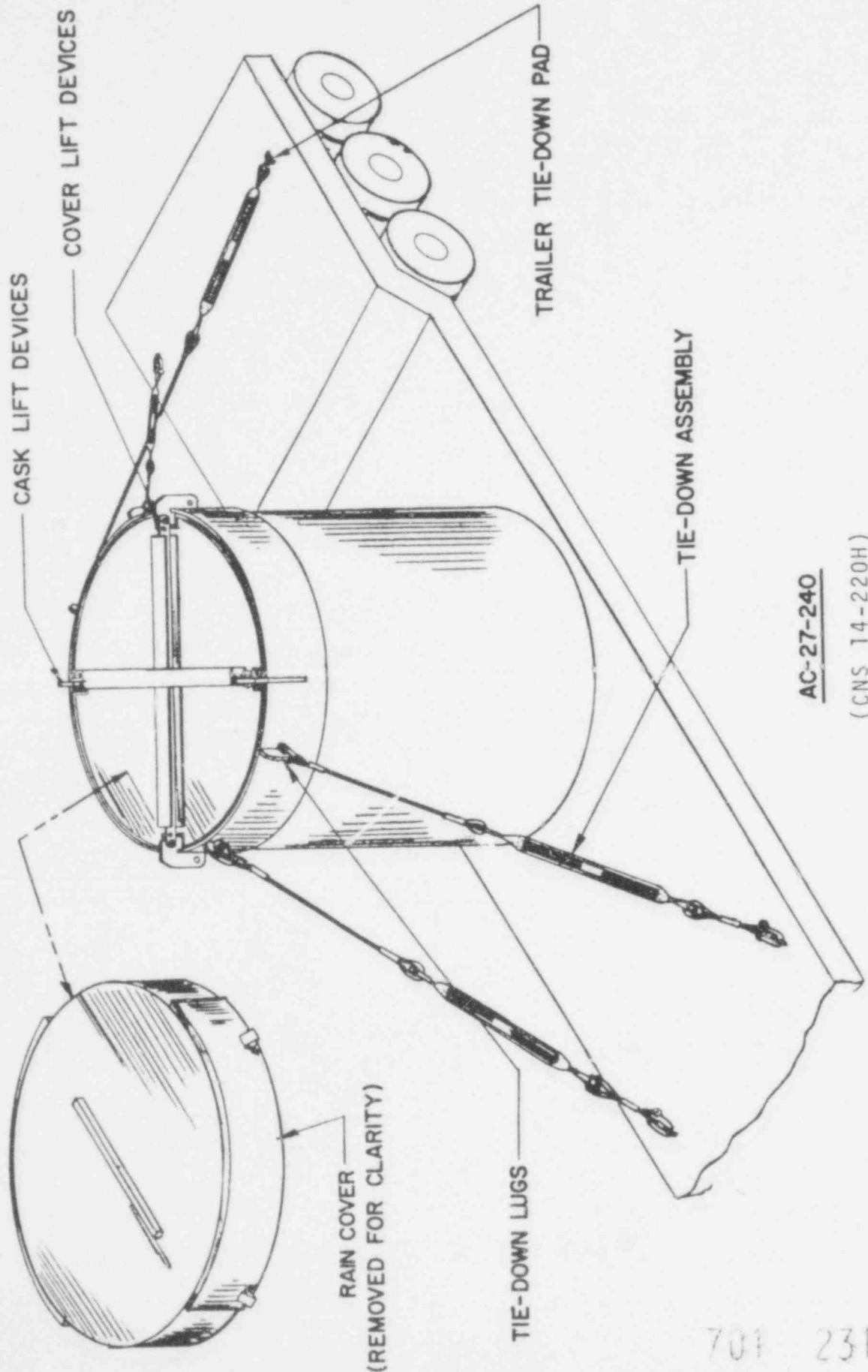
701 229



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DISPOSABLE CONTAINER  
 CAPACITY..200 CU. FT.  
 FOR CASK -  
 AC-27-24OL(14-220)



**AC-27-240**

(CNS 14-220H)

701 231

TRANSPORT CASK

ATCOR AC-27-240 (CNS 14-220H)

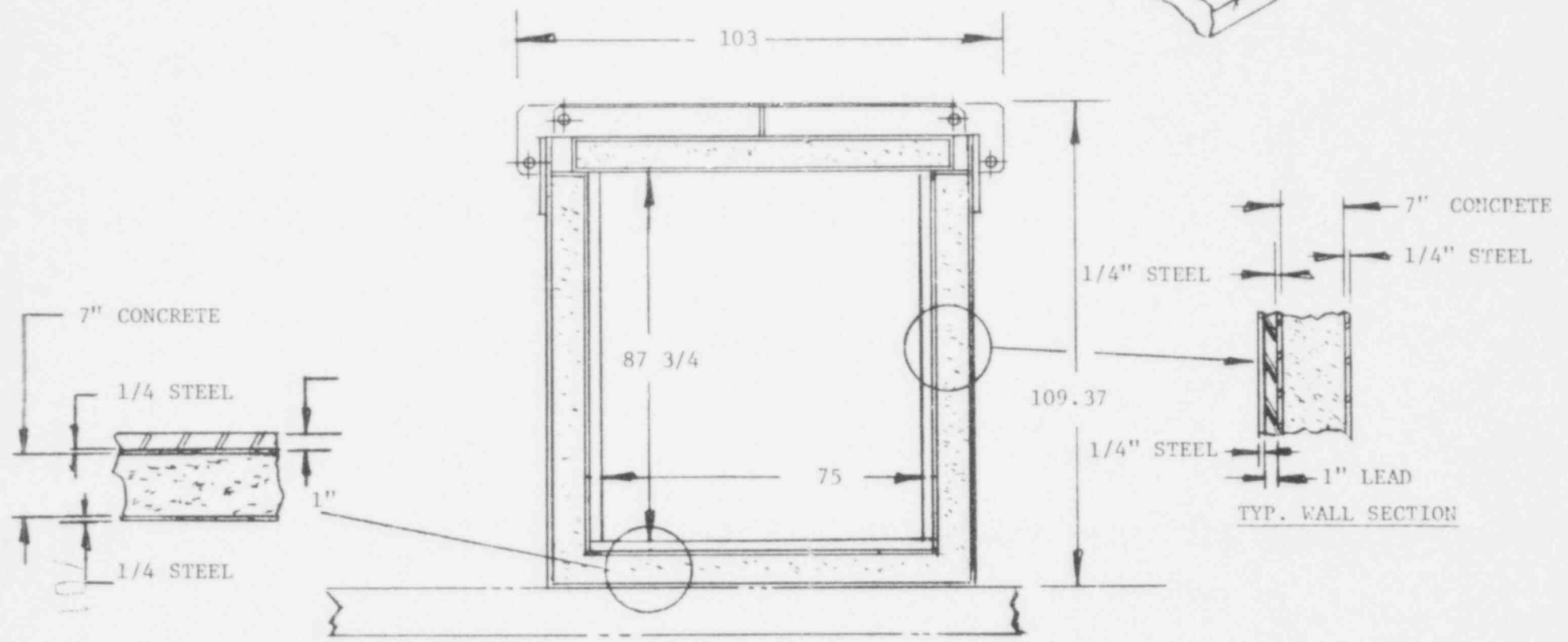
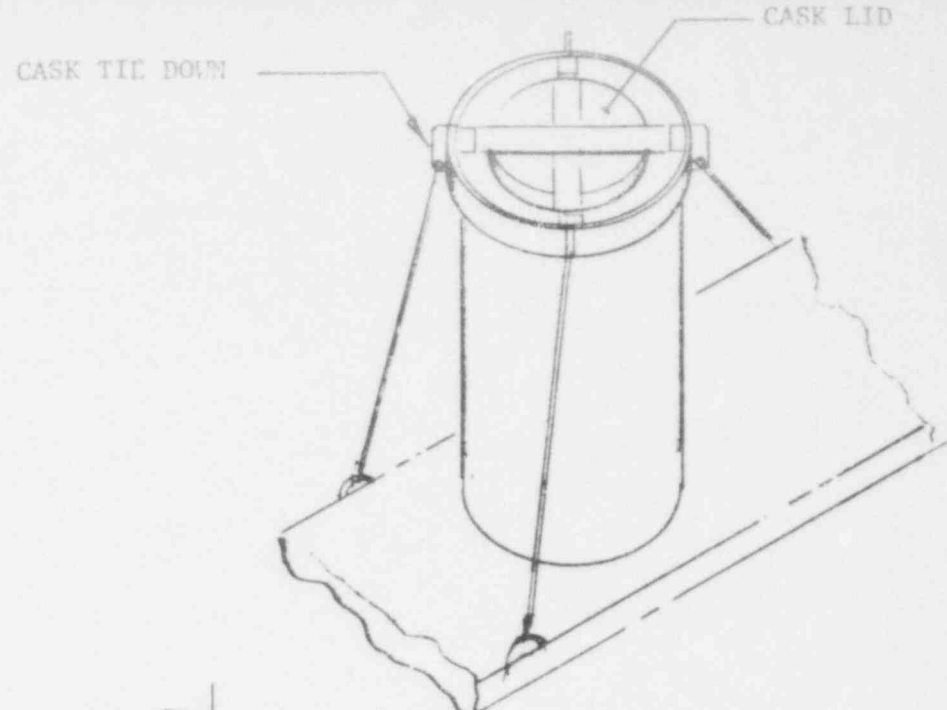
SHIELDING: 2 - 3/4 IN. LEAD EQUIV.

CAPACITY: (14) 55 GAL. DRUMS

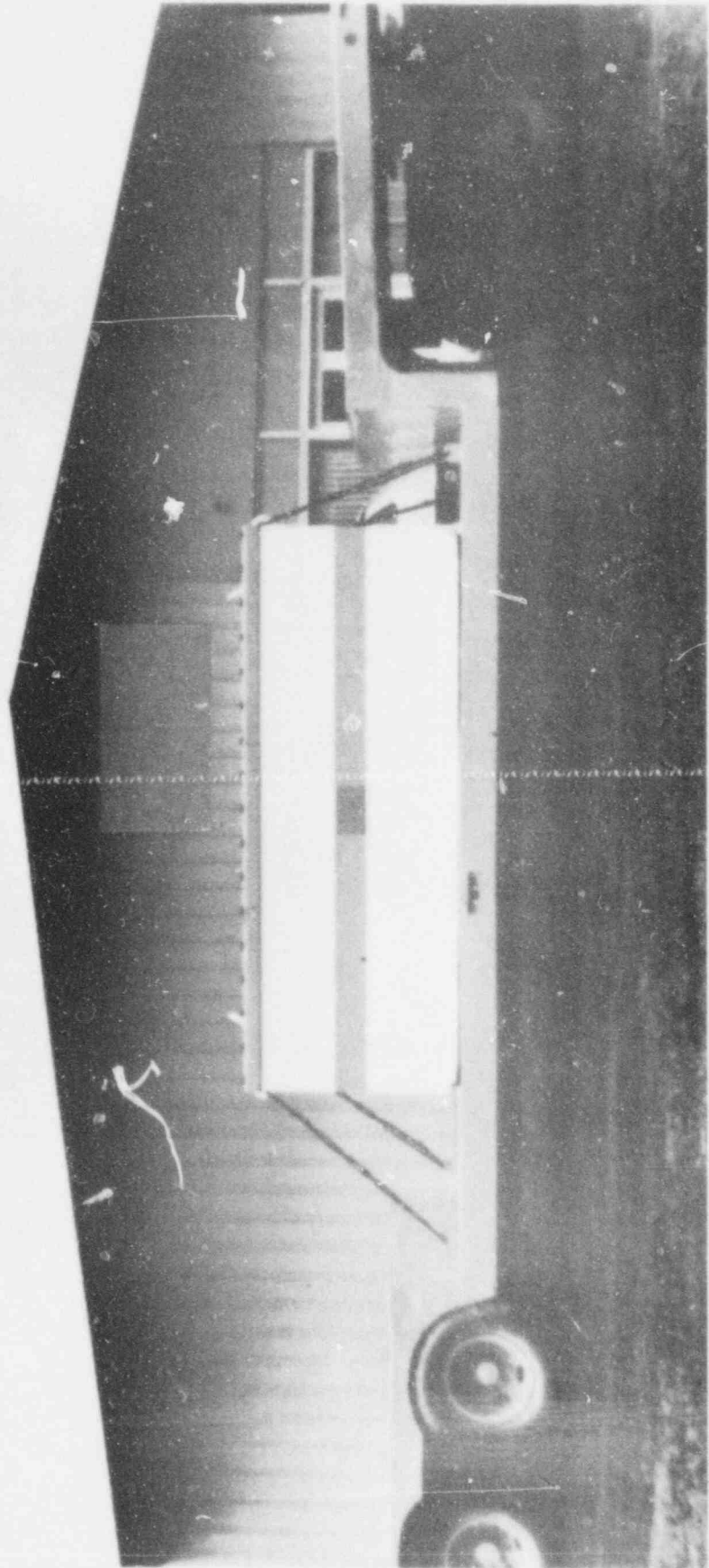
WEIGHT: GROSS WT. (EMPTY)

39,900 LBS.

STRONG TYPE CONTAINER



232



**POOR ORIGINAL**

701 233

**CHEM-NUCLEAR SYSTEMS, INC.**

CNS 15-1605  
SHIELDING: 2.50 IN. LEAD EQUIV.  
CLASSIFICATION: STRONG TIGHT CONTAINER

CAPACITY

(5) 55 GAL. DRUMS OR  
(2) 80 CU. FT. CONTAINERS

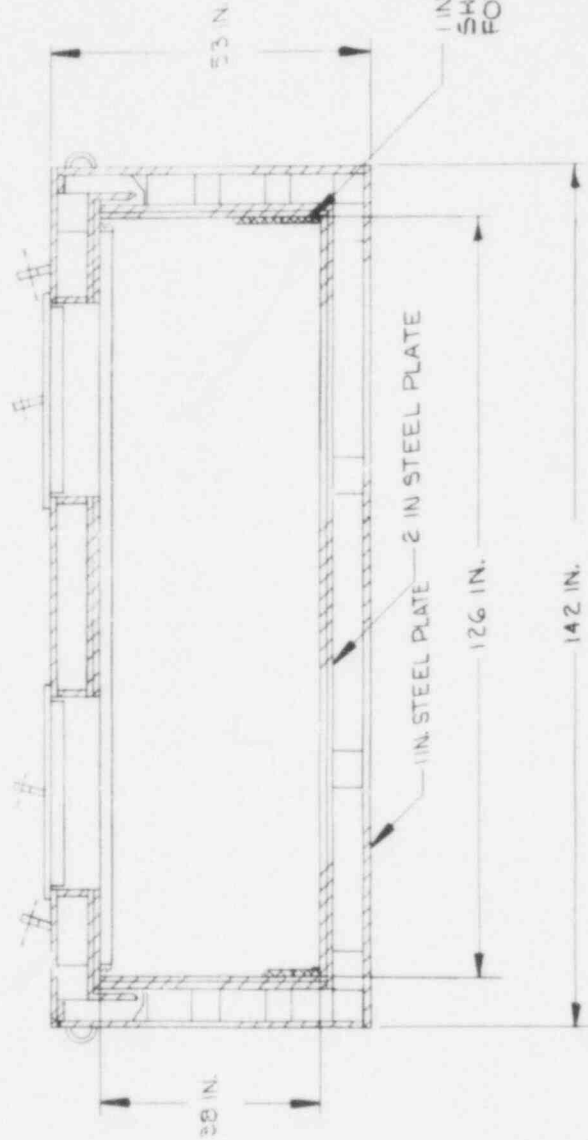
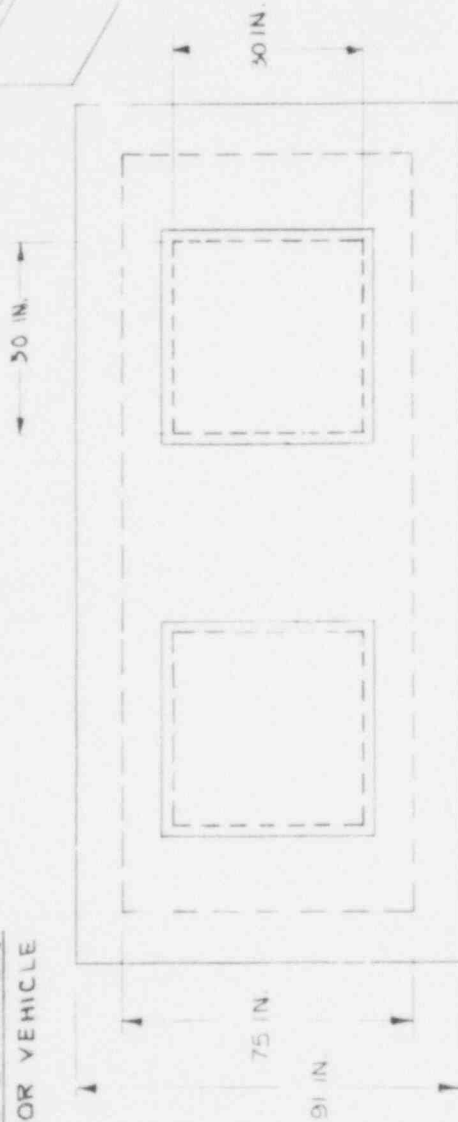
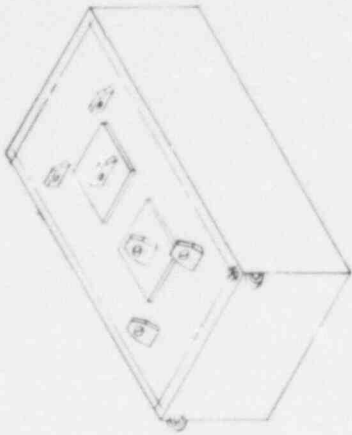
WEIGHT

GROSS WEIGHT: 42,000 LBS. (EMPTY)

CASK LID: 12,000 LBS.

MODE OF TRANSPORTATION

MARINE OR MOTOR VEHICLE



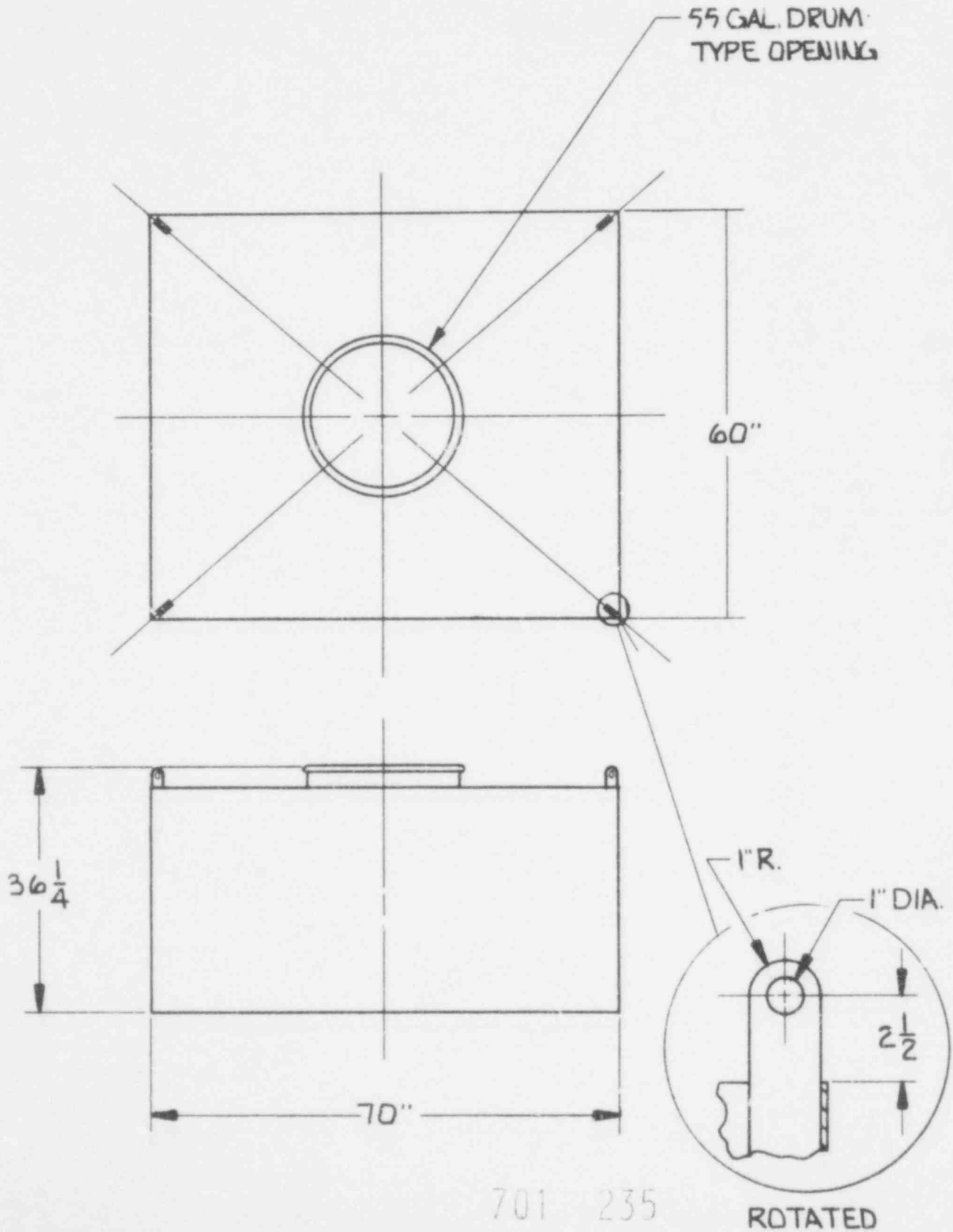
REV. 1

701 234



DISPOSABLE CONTAINER  
15-160 CASK  
CAPACITY 80 CU. FT.

Rev. 1

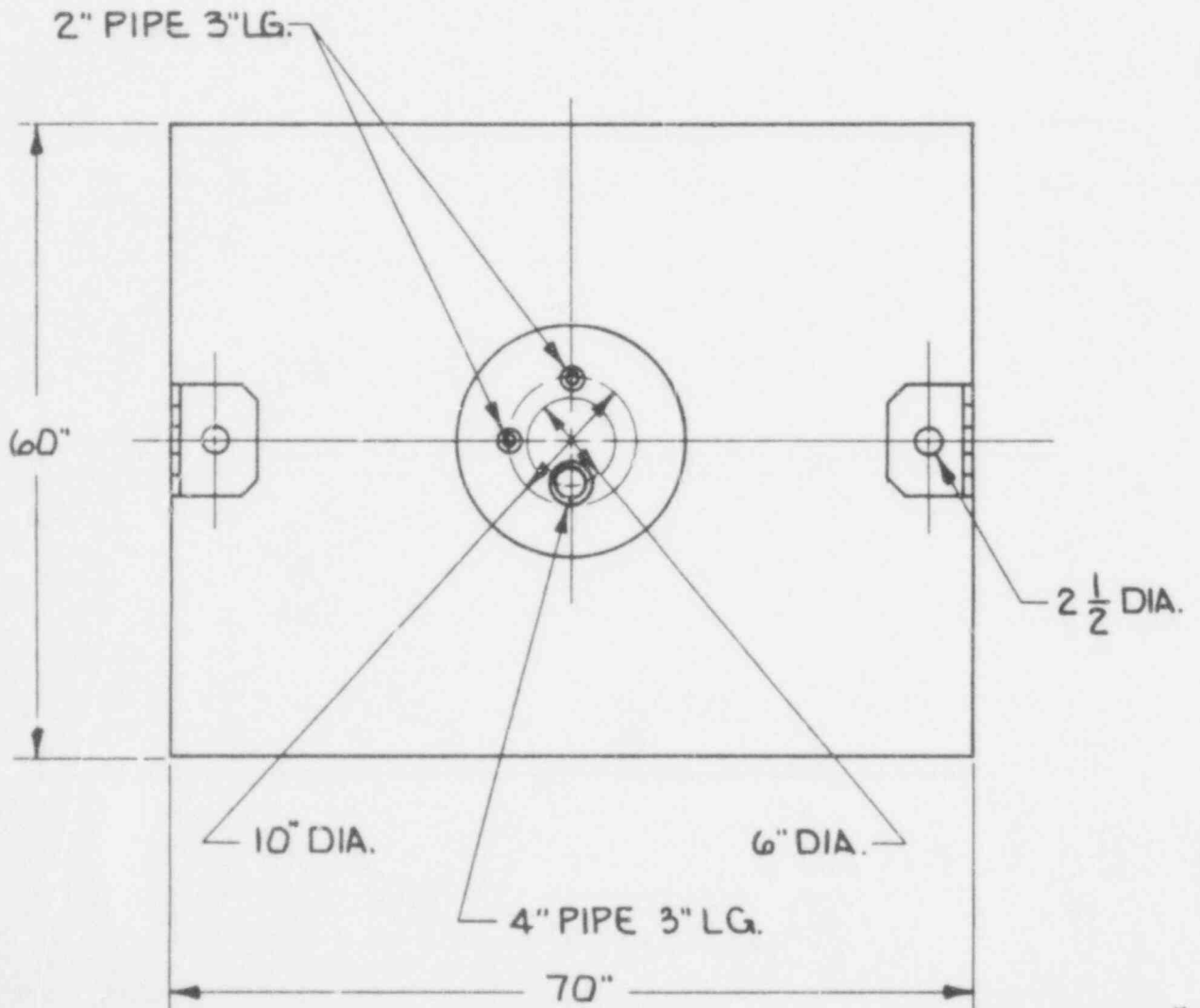
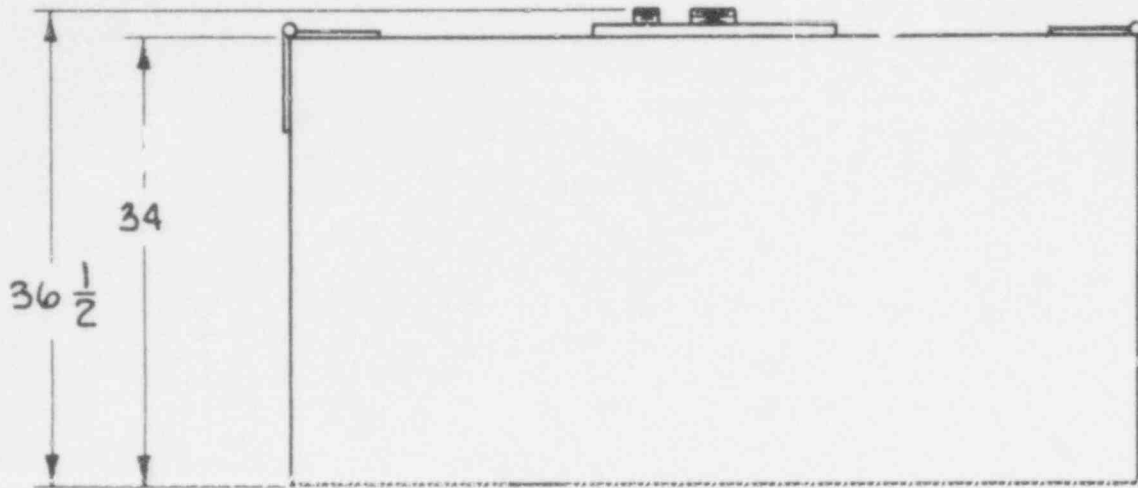


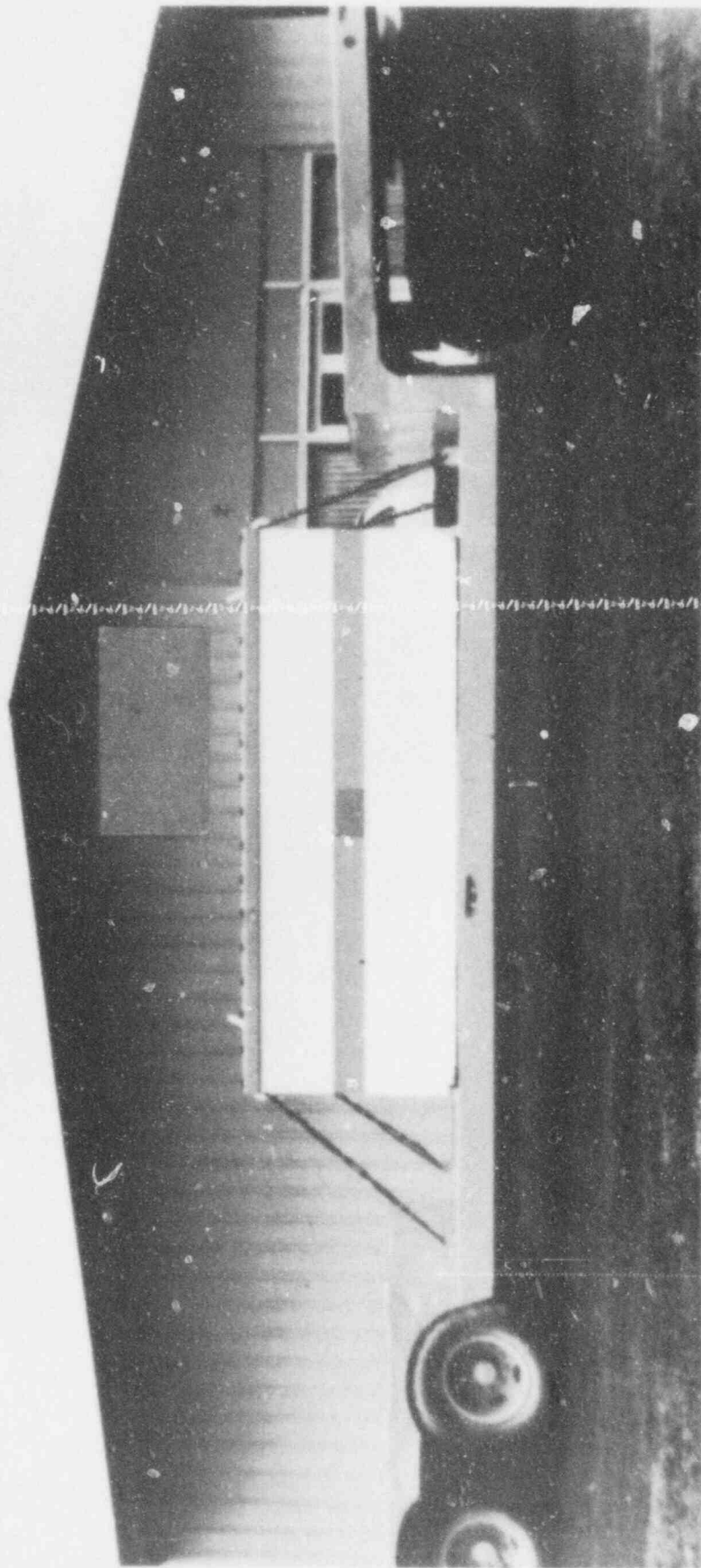
701 235

ROTATED

DISPOSABLE CONTAINER  
15-160 CASK  
CAPACITY 80 CU. FT.

Rev. 1





POOR ORIGINAL

701-237

**CHEM-NUCLEAR SYSTEMS, INC.**

CNS 15-160B  
SHIELDING: 1.50 IN. LEAD EQUIV.  
USNRC PACKAGE IDENT. NO. USA/3144/B

CAPACITY

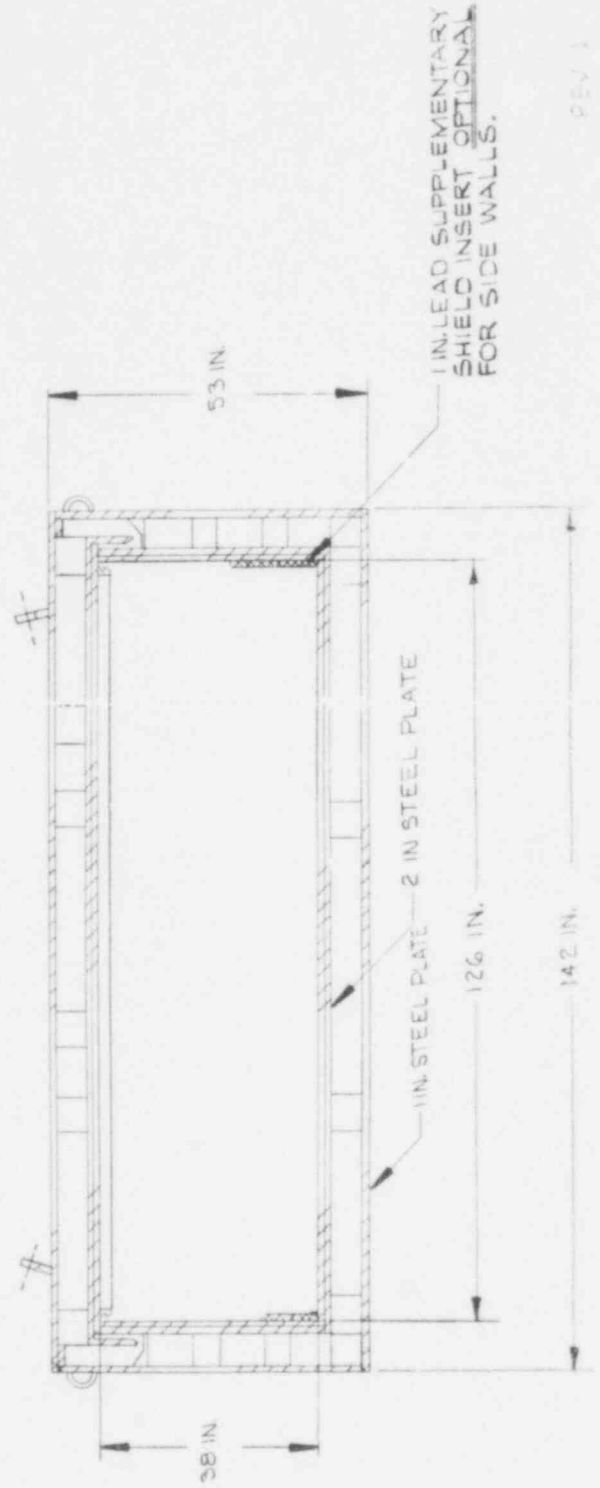
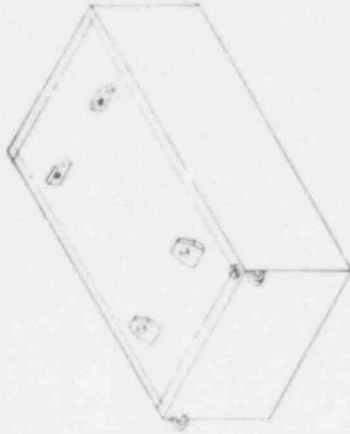
(5) 55 GAL. DRUMS OR  
(2) 80 CU. FT. CONTAINERS

WEIGHT

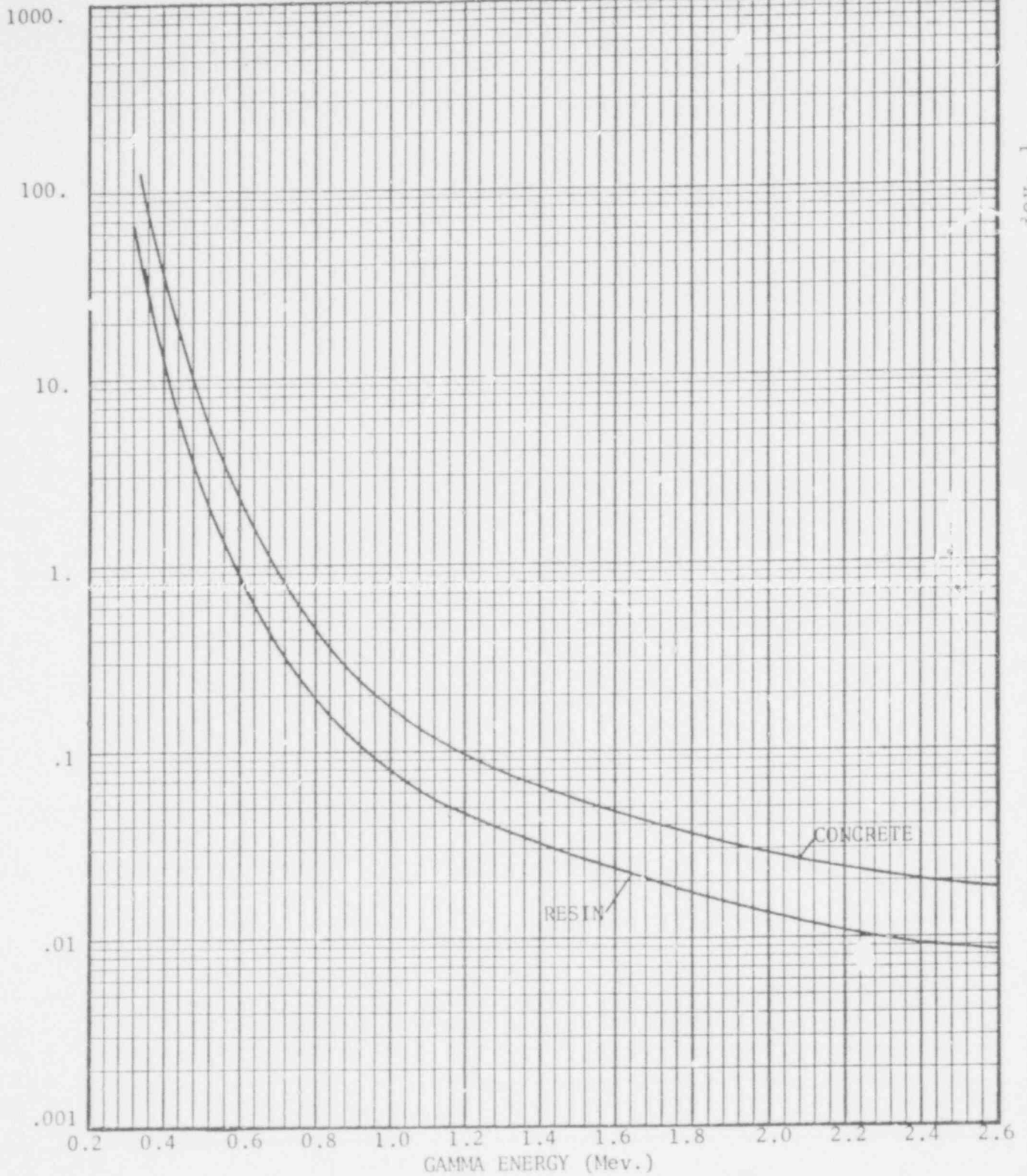
GROSS WEIGHT: 37,000 LBS. (EMPTY)  
CASK LID: 12,000 LBS.

MODE OF TRANSPORTATION

MARINE OR MOTOR VEHICLE



\*\* CURIES/FT.<sup>3</sup>



## CHEM-NUCLEAR SYSTEMS, INC.

\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

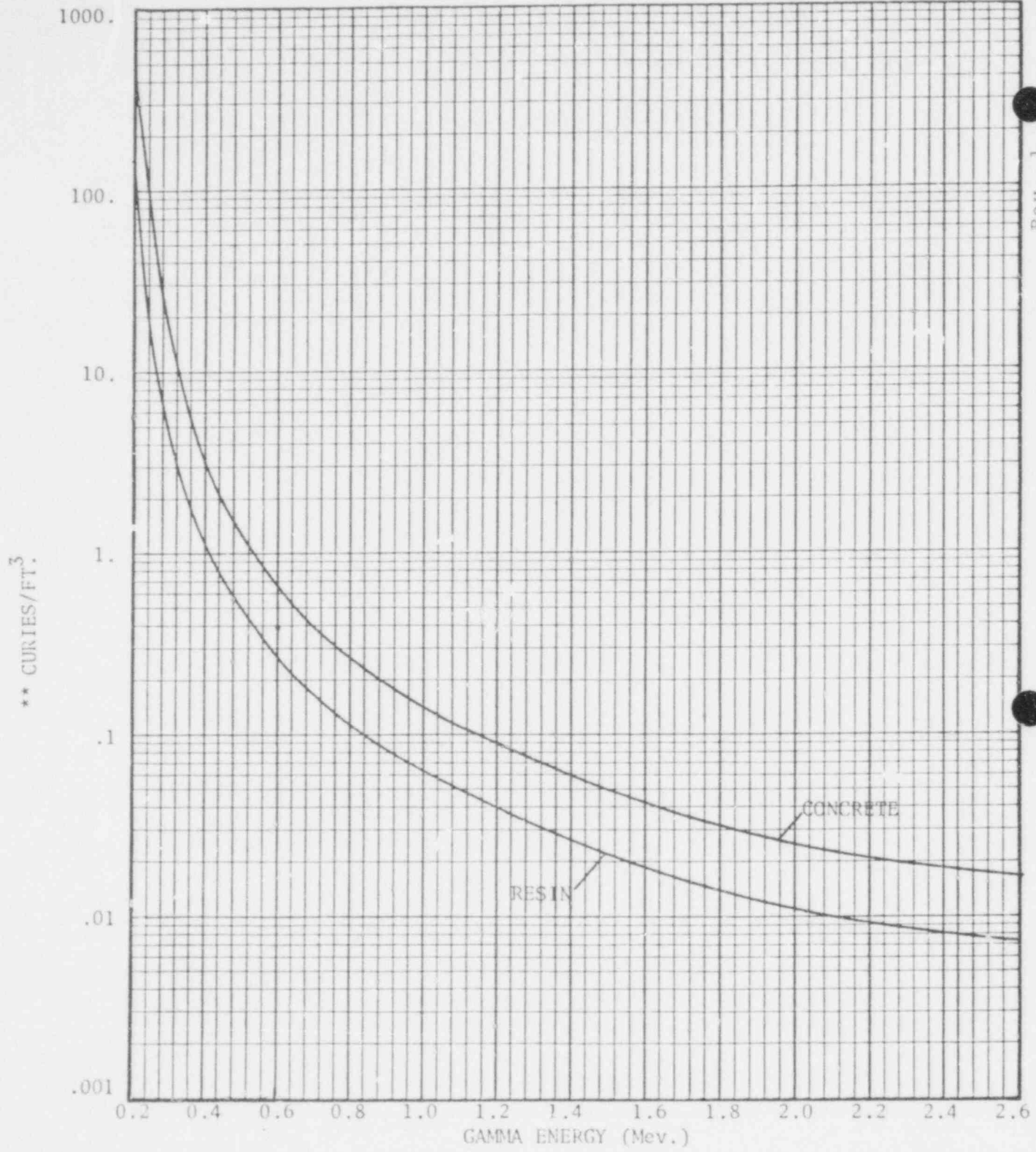
CASK 15-160-B 3 INCHES STEEL, 3/4 INCH LEAD  
SHIELDING ON SIDE

701 239

REV.

DATE

SHEET



\*\*BASED ON HOMOGENEOUS MIX  
DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

### CHEM-NUCLEAR SYSTEMS, INC.

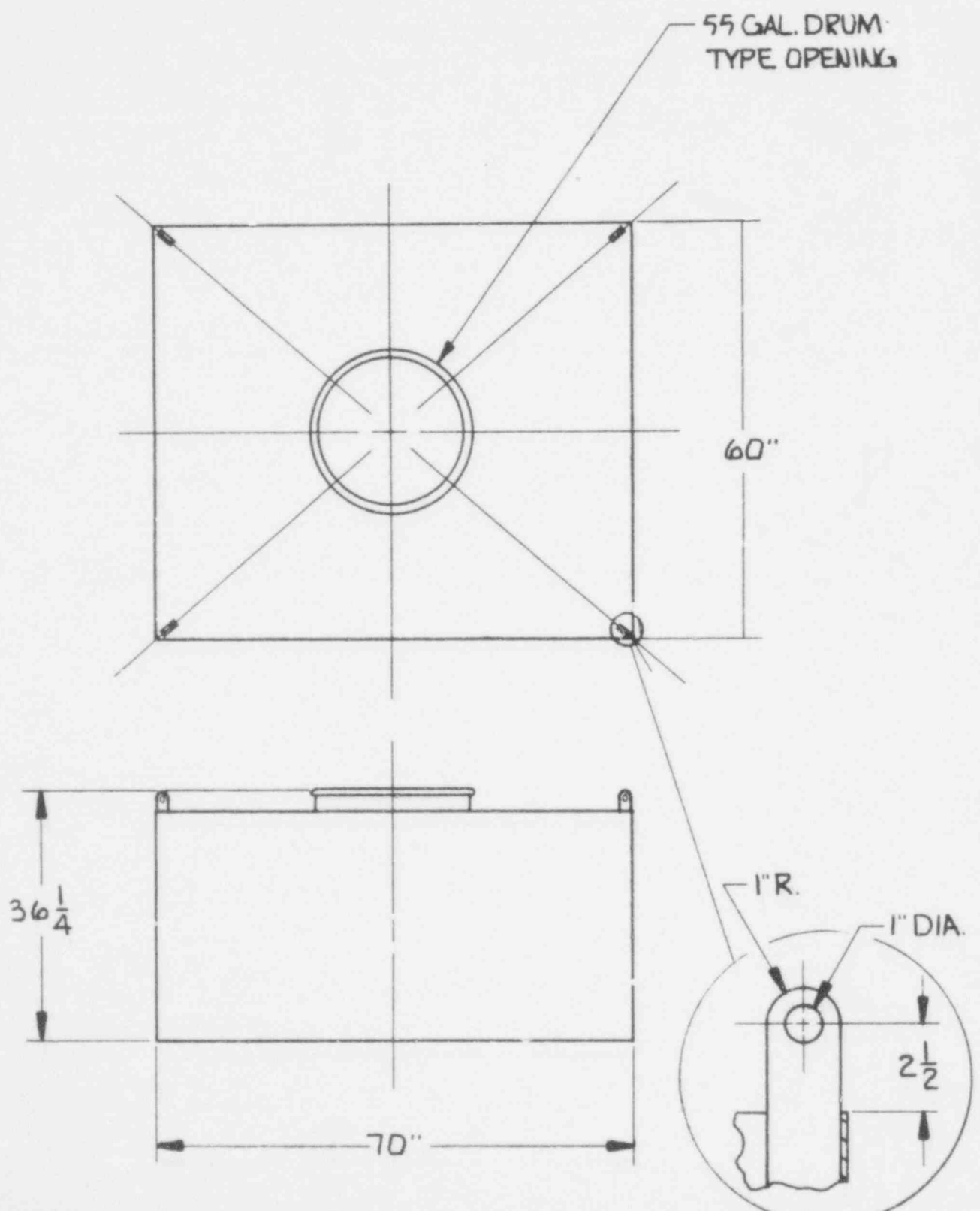
CASK 15-160-B 4 INCHES STEEL  
SHIELDING ON TOP

701 240

REV.	DATE	SHEET
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DISPOSABLE CONTAINER  
15-160 CASK  
CAPACITY 80 CU FT.

Rev. 1

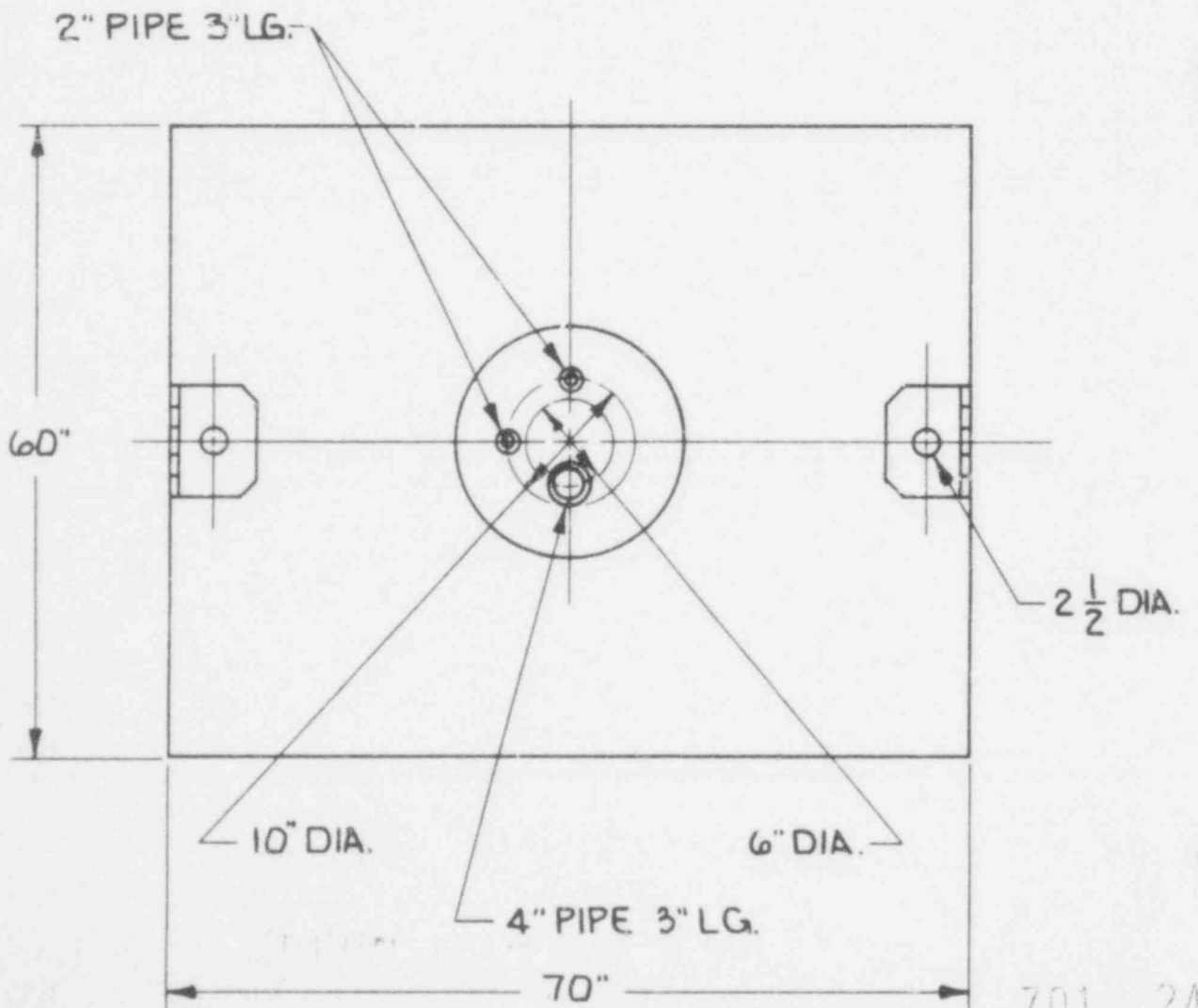
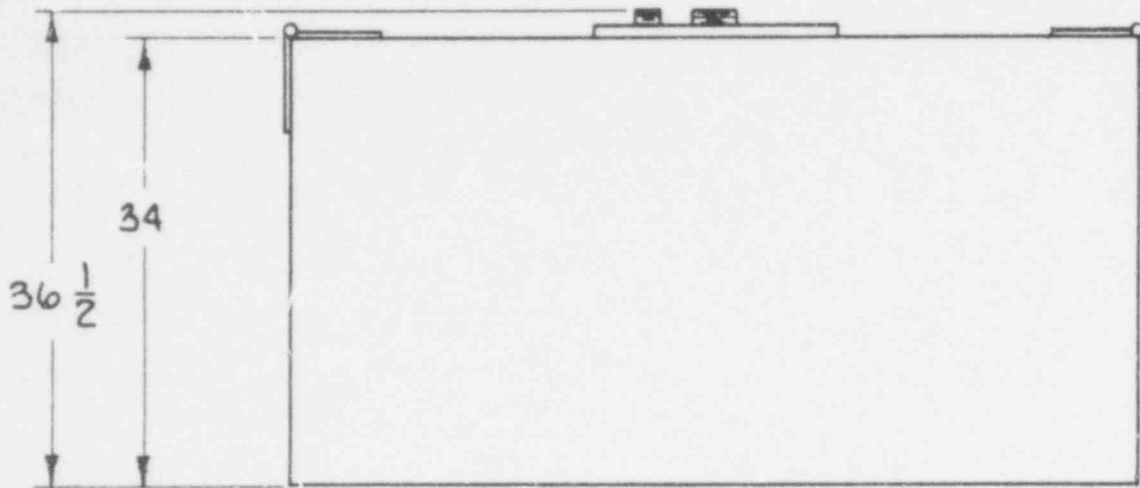


701 241

ROTATED

DISPOSABLE CONTAINER  
15-160 CASK  
CAPACITY 80 CU. FT.

Rev. 1







POOR ORIGINAL

701 243

**CHEM-NUCLEAR SYSTEMS, INC.**

CNS 1B-450 LARGE VOLUME LSA TRANSPORT CASK  
SHIELDING:

WITH INSERT SHIELD- 3.70 IN. LEAD EQUIV.  
W/O INSERT SHIELD- 1.84 IN. LEAD EQUIV.

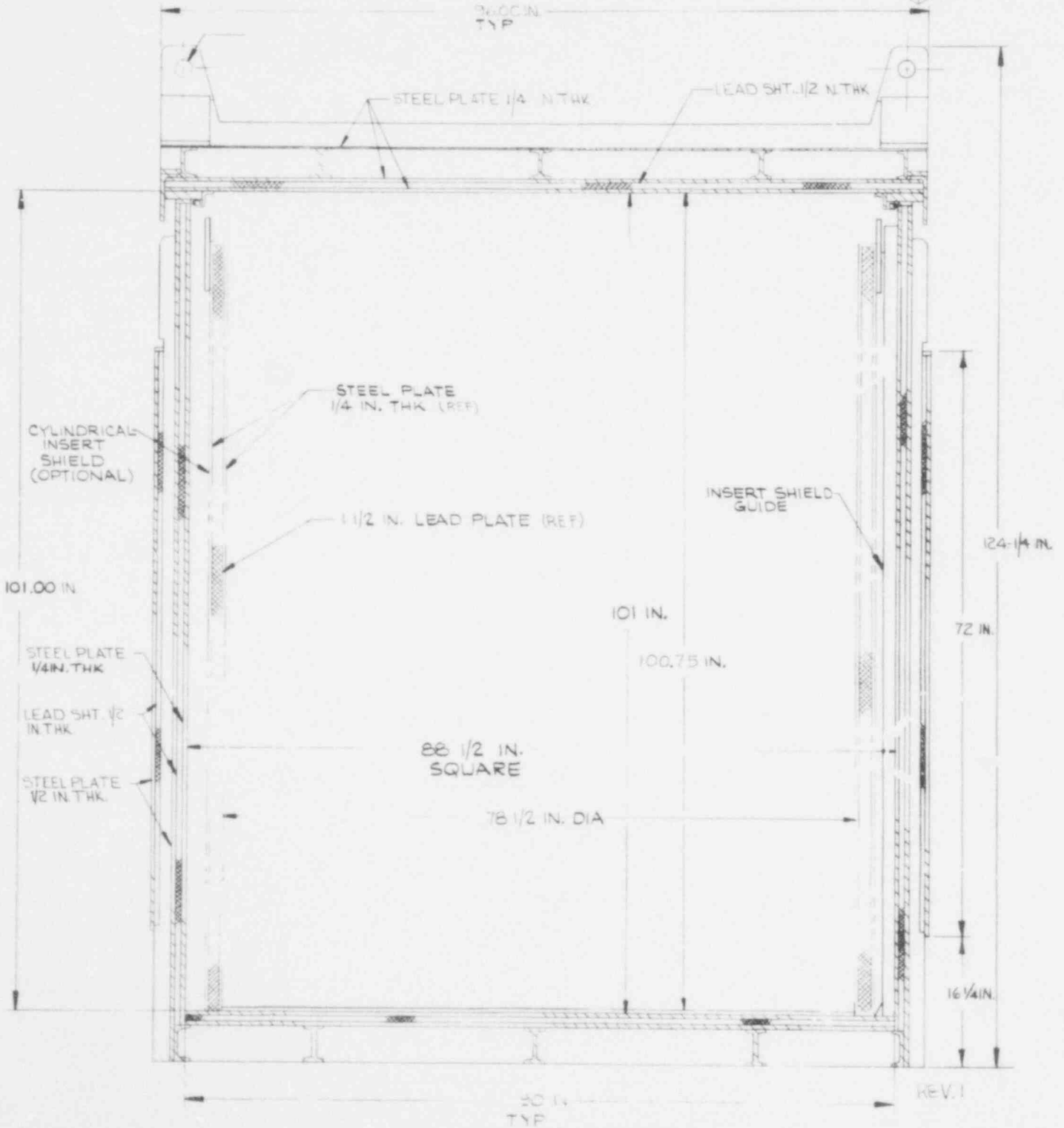
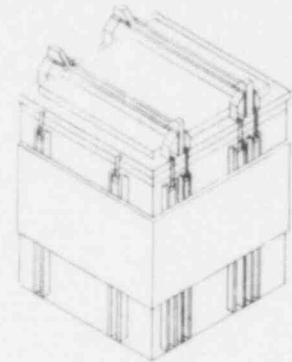
CLASSIFICATION: SPEC 55

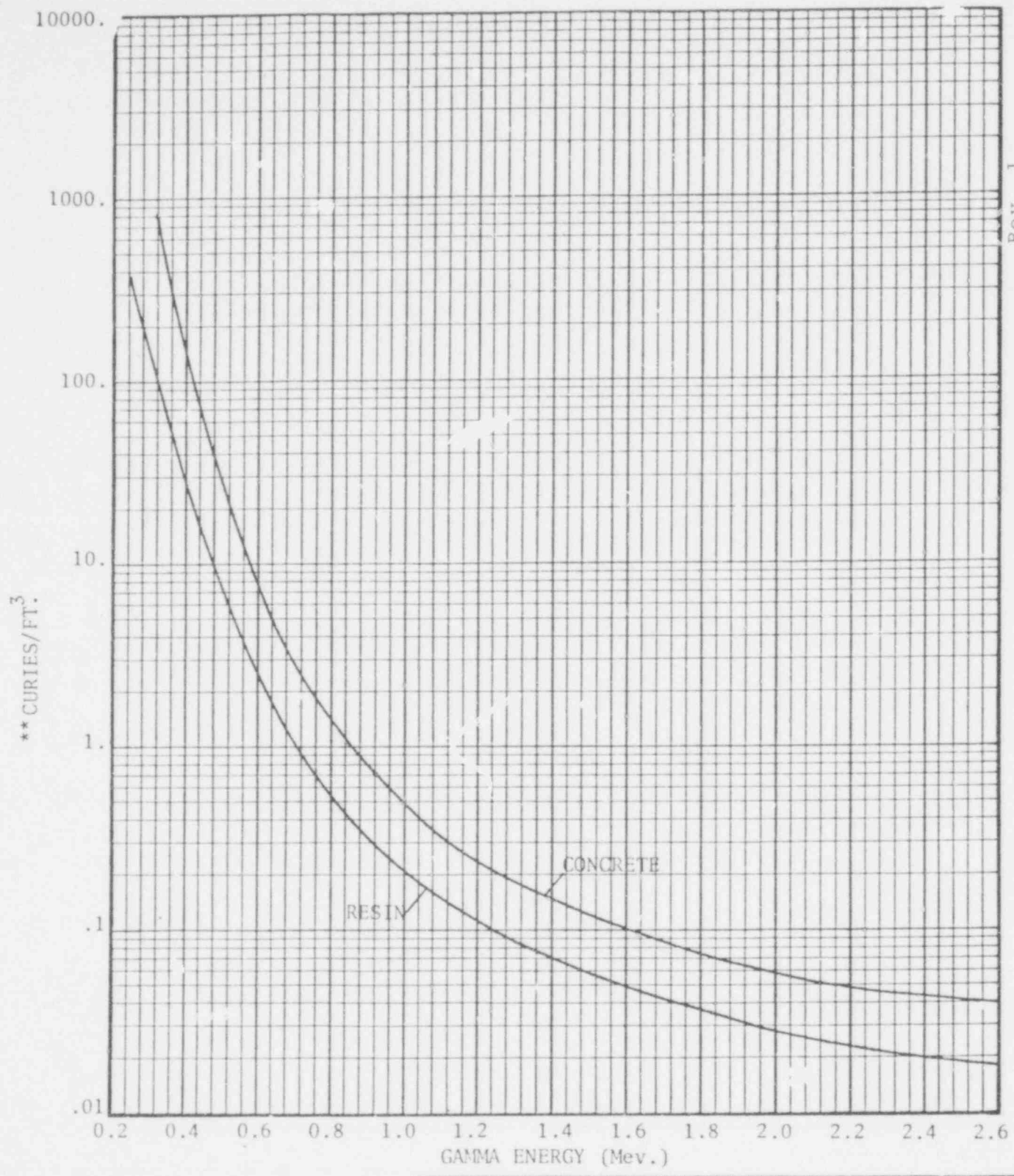
CAPACITY

(13) 55 GAL. DRUMS OR  
(1) 308 CU. FT. CONTAINER

WEIGHT

GROSS WEIGHT: 36,950 LBS.(EMPTY)  
GROSS WEIGHT WITH INSERT: 59,480 LBS.(EMPTY)  
LID WEIGHT: 5250 LBS.





Rev. 1

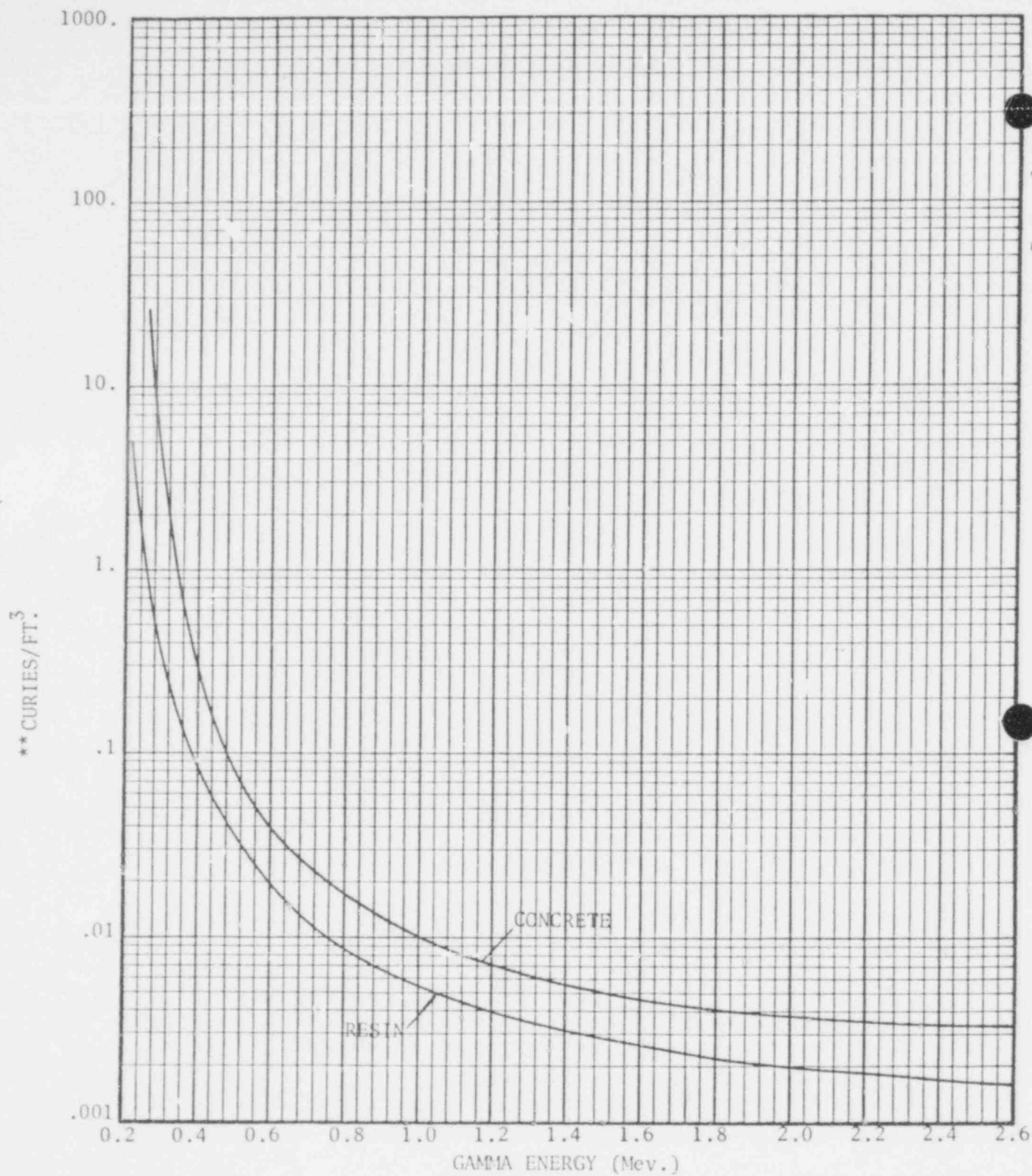
## CHEM-NUCLEAR SYSTEMS, INC.

CASK 18-450 1/2 INCH STEEL, 1/2 INCH LEAD  
 3-3/4 INCHES STEEL  
 SHIELDING ON SIDE

701 245

\*\*BASED ON HOMOGENEOUS MIX  
 DOSE RATE AT 6 FEET  
 FROM CASK IS 10 MR/HR

REV.	DATE	SHEET
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\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET  
FROM CASK IS 10 MR/HR

## CHEM-NUCLEAR SYSTEMS, INC.

CASK 18-450 1/2 INCH STEEL, 1/2 INCH LEAD,  
1/4 INCH STEEL  
SHIELDING ON TOP

701 246

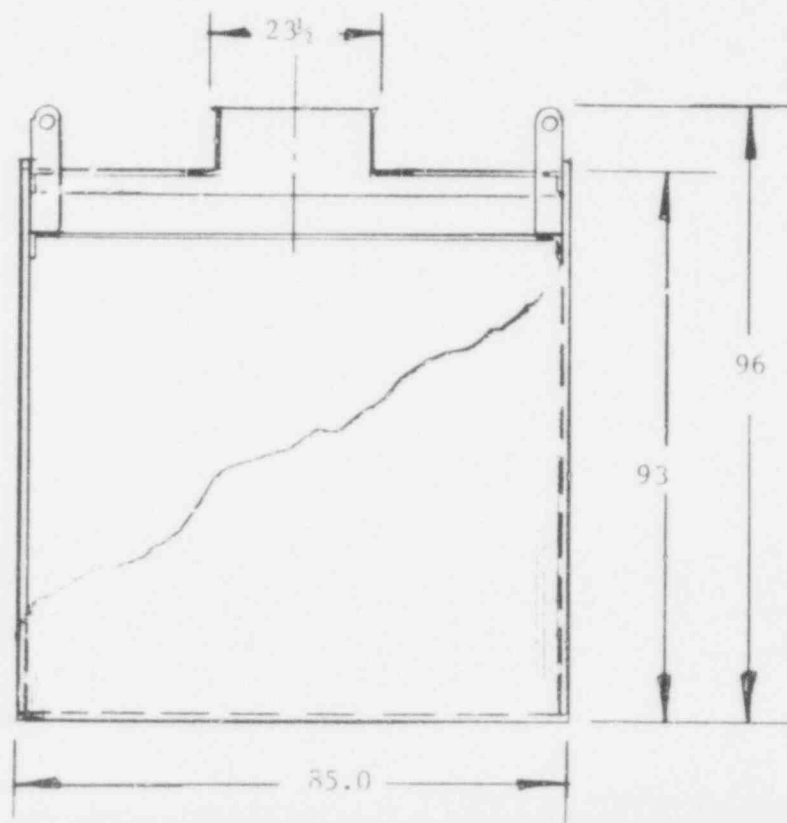
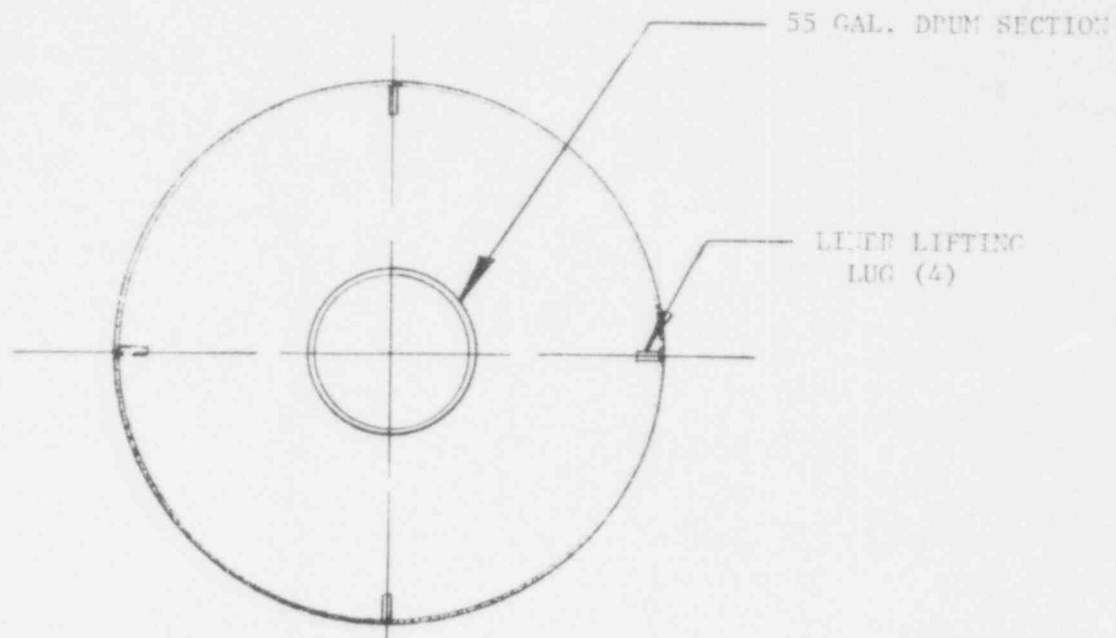
REV.

DATE

SHEET

CHEM-NUCLEAR SYSTEMS, INC.

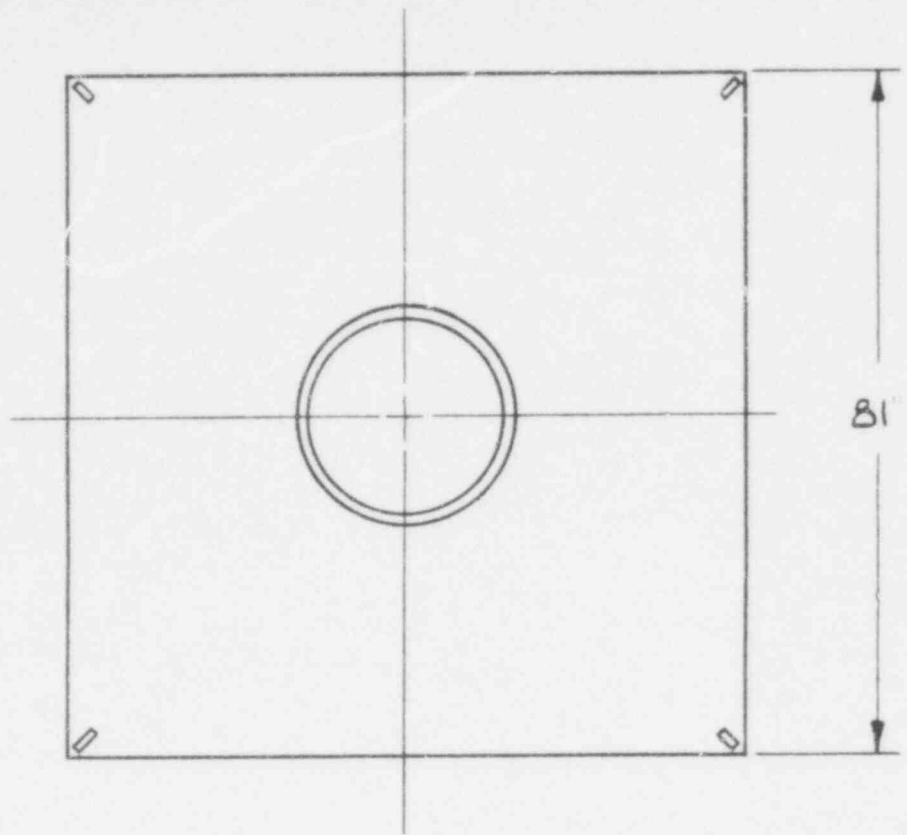
LINER-SOLID WASTE  
USED ON CASK 18-450  
CAPACITY 306 CU. FT.



701 247

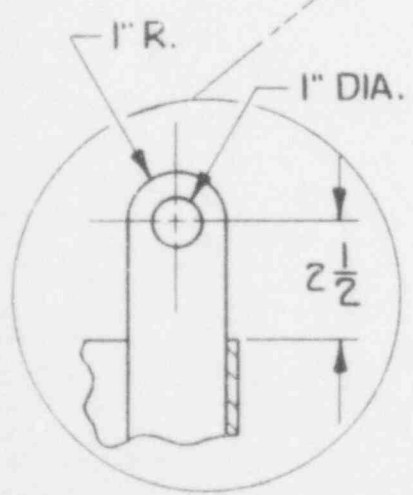
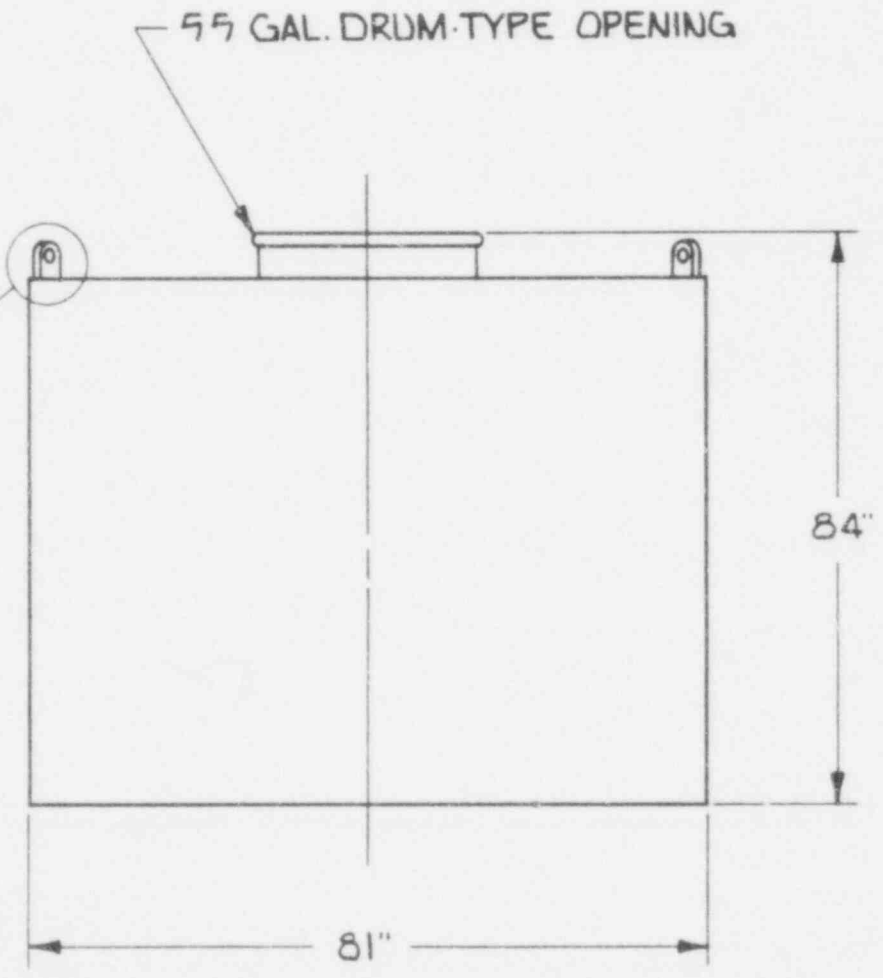
Rev. 1

DISPOSABLE CONTAINER  
18-4.50 CASK  
CAPACITY 308 CU. FT.

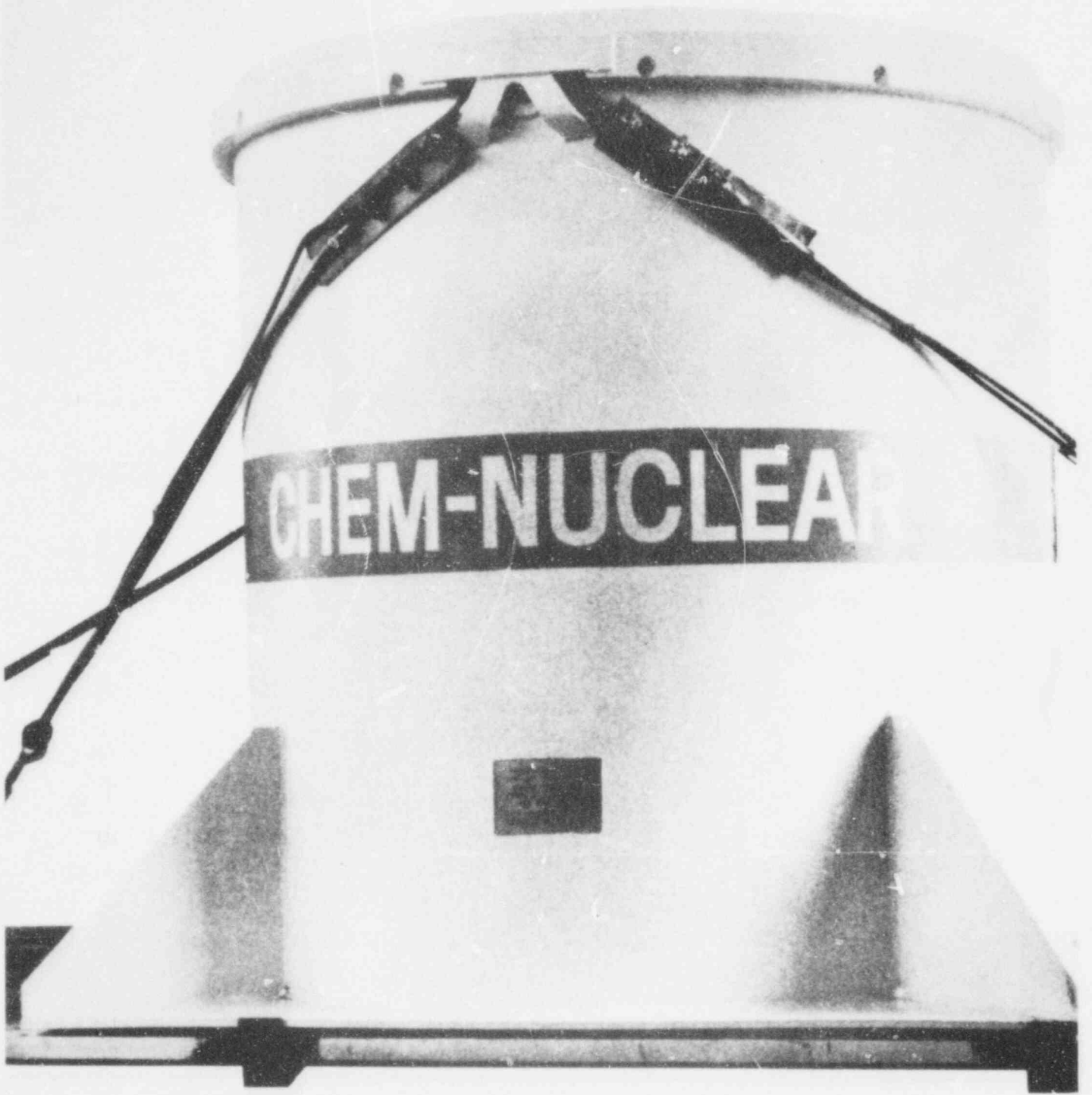


Rev. 1

55 GAL. DRUM-TYPE OPENING



ROTATED



**POOR ORIGINAL**

CHEM-NUCLEAR SYSTEMS, INC.  
CNS 21-300

701 249

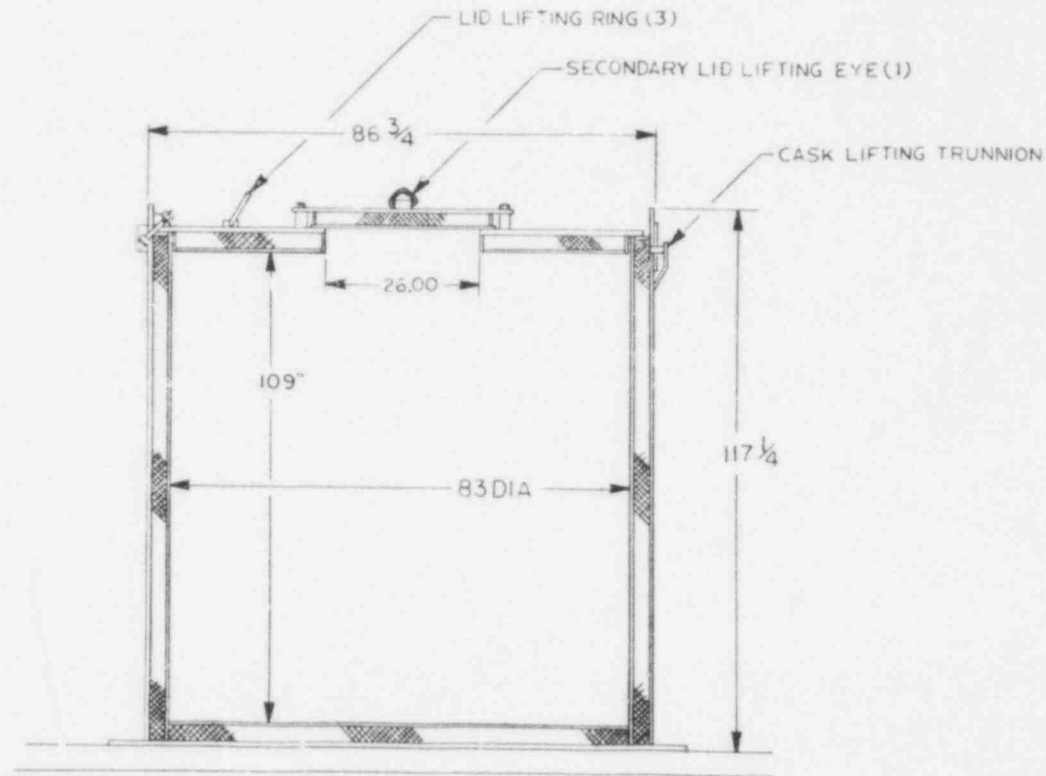
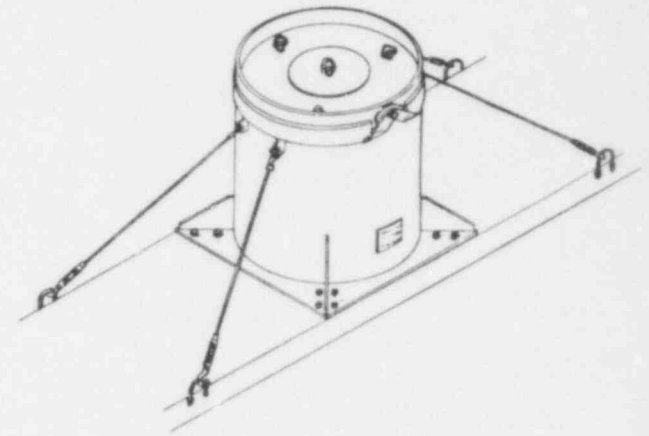
**CHEM-NUCLEAR SYSTEMS, INC.**

TRANSPORT CASK  
C.N.S. 21-300  
SHIELDING 1.50 IN. LEAD EQUIV.  
USA DOT SPEC. 7A, TYPE A  
U.S.N.R.C. PACKAGE IDENT. NO. USA/ 9096/A  
CAPACITY

(2) 55 GAL. DRUMS  
OR (1) 315 CU. FT. CONTAINER

WEIGHT

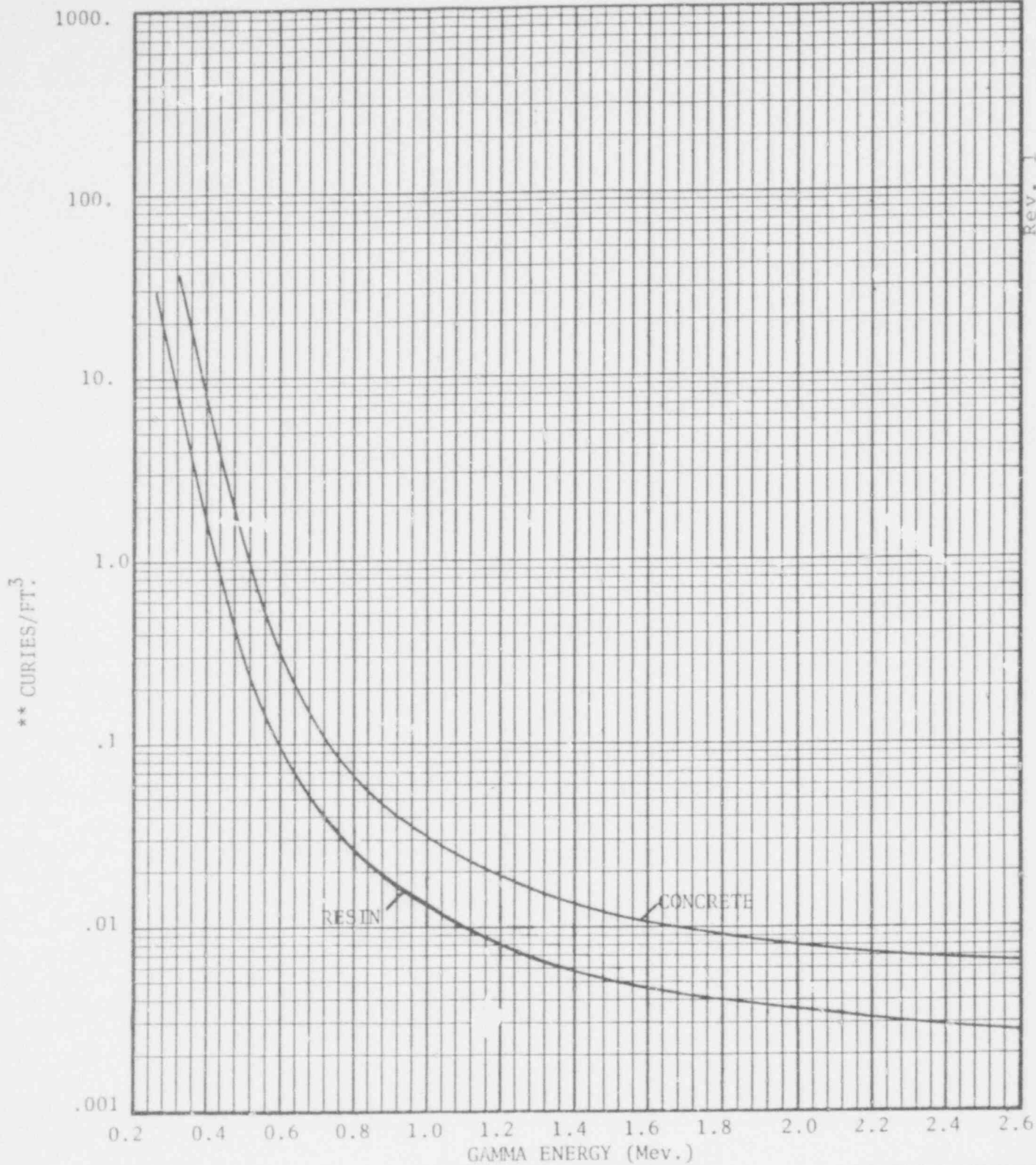
GROSS WT. (EMPTY) 30,200 LBS.  
CASK LID 3,450 LBS.  
SECONDARY LID 550 LBS.



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Rev. 1

\*\* CURIES/FT.<sup>3</sup>

**CHEM-NUCLEAR SYSTEMS, INC.**

\*\*BASED ON HOMOGENEOUS MIX

DOSE RATE AT 6 FEET FROM CASK IS 10 MR/HR

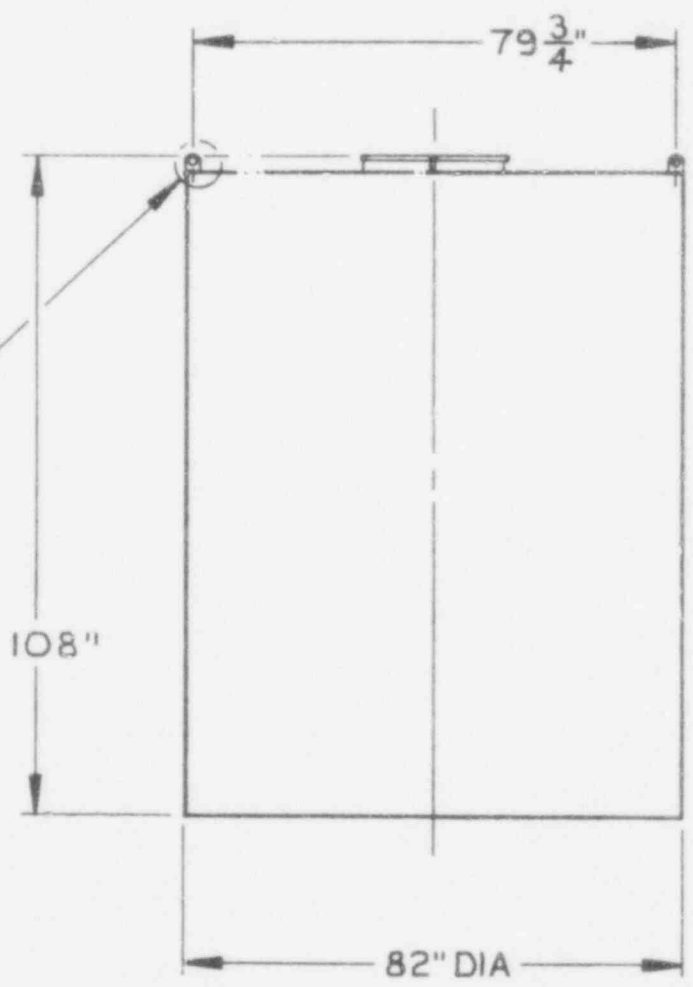
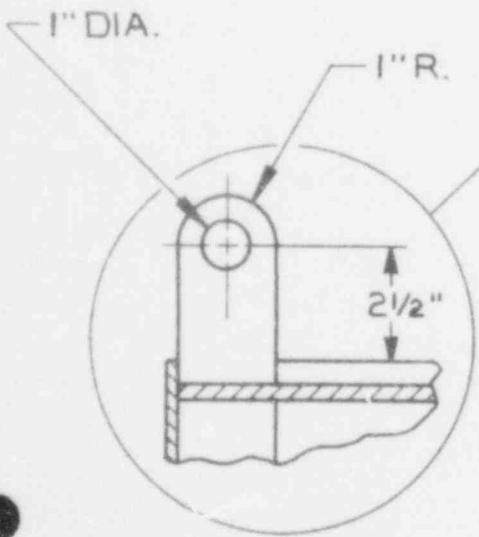
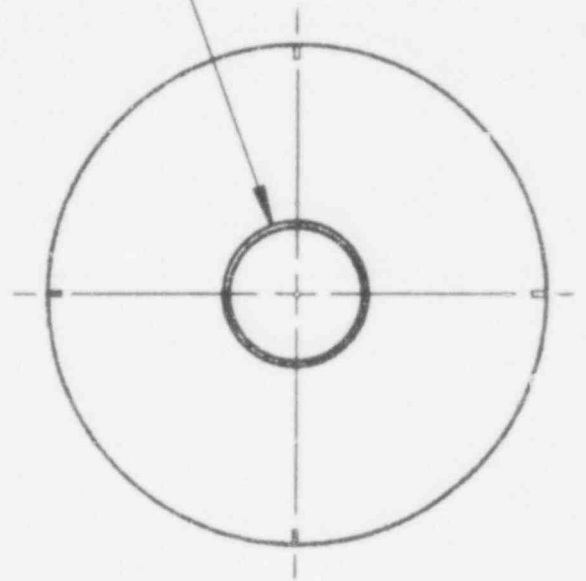
CASK 21-300 7/8 INCHES STEEL, 1 INCH LEAD

701 251

REV.	DATE	SHEET
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DISPOSABLE CONTAINER  
21-300 CASK  
CAPACITY.... 322 CU.FT.  
D.O.T. SPEC. 7A

55 GAL. DRUM - TYPE  
OPENING



701 252